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| March 2021 (fin. 4 April 2022) | |

[www.africa-rising.net](http://www.africa-rising.net)

Africa RISING East and Southern Africa Project

2020/2021 Workplan

The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-in-development projects supported by the United States Agency for International Development as part of the U.S. government’s Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three regional projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads the program’s monitoring, evaluation and impact assessment. <http://africa-rising.net/>

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# Partners and their responsibilities

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Acronym** | **Role/responsibility** | |
| Government Ministries & Entities | | | |
| District Government Authorities |  | Facilitating (farmer) contacts, supervising field activities & scaling | |
| Machinga District Council Agriculture Development Division | Machinga ADD | Taking technologies to scale | |
| National Academic and National Research Institutions | | | |
| Tanzania Agricultural Research Institute | TARI | Research and scaling with its Centres Selian, Naliendele, Hombolo, and, Dakawa | |
| Zambia Agriculture Research Institute | ZARI | Research and scaling with Msekera Research Institute | |
| Sokoine University of Agriculture | SUA | Research and technology delivery; graduate student training | |
| University of Dodoma | UDOM | Research and technology delivery; graduate student training | |
| Bonn University |  | Model land degradation | |
| Kenyatta University |  | Ph.D. student | |
| University of Zimbabwe |  | MSc Students | |
| University of Amsterdam | UvA | MSc student | |
| Lilongwe University of Agriculture and Natural Resources | LUANAR | Implementing research and scaling; graduate student training | |
| International Research Institutions and Universities | | | |
| International Institute of Tropical Agriculture | IITA | Project Management, research, and technology delivery; student mentoring | |
| International Center for Tropical Agriculture | CIAT | Research and technology delivery; student mentoring | |
| International Crops Research Institute for the Semi-Arid Tropics | ICRISAT | Research and technology delivery; student mentoring | |
| International Food Policy Research Institute | IFPRI | Monitoring & Evaluation and research | |
| International Livestock Research Institute | ILRI | Research and technology delivery; student mentoring | |
| International Maize and Wheat Improvement Centre | CIMMYT | Research and technology delivery; student mentoring | |
| World Vegetable Centre | WorldVeg | Research and technology delivery; student mentoring | |
| World Agroforestry Centre | ICRAF | Research and technology delivery; student mentoring | |
| Michigan State University | MSU | Research and technology delivery; student mentoring | |
| Wageningen University and Research Centre | WUR | Research and technology delivery; student mentoring | |
| Non-government and private organizations and development projects | | | |
| Cereals Market System Development | NAFAKA | | A consortium of private and public development partners for taking technologies to scale |
| Dodoma Agricultural Seed Producers’ Association | DASPA | | Development partner assisting to take technologies to scale |
| Iles de Paix (Islands of Peace) | IDP | | A consortium of private and public development partners for taking technologies to scale |
| Catholic Relief Services | CRS | | Taking technologies to scale |
| Community Market for Conservation | COMACO | | Taking technologies to scale |
| Total Land Care | TLC | | Taking technologies to scale |
| Leadership formation, Environmental Conservation & Action for Development Foundation | LEAD | | Promote best principles and practices of leadership, environmental conservation, and community development |
| Community Support Initiatives Tanzania | COSITA | | Scaling partner |
| Research Community and Development Association | RECODA | | Scaling partner |
| National Farmers’ Organization Tanzania | MVIWATA | | Scaling partner |

# Summary

The Africa RISING East and Southern Africa (ESA) project is being implemented by multi-disciplinary research teams and development partners from the public and private sectors in collaboration with farmers and community-based organizations in Tanzania and Malawi. This document presents the work plan for the 2020-2021 research year for ESA mapped under the five Outcomes in the Phase 2 project log frame as reflected in Table 2. Forty sub-activity workplans are presented – nine for Outcome 1, four for Outcome 2, three for Outcome 3, and 20 for Outcome 5. Like the 2019-2020 work plan, the 2020-2021 workplan focuses more on Outcome 5 which is specifically designed for knowledge and validated technology transfer to development partners, including developing their capacities to take them to scale. It is these actions that will generate impacts of applying Africa RISING technologies, at scale. An overview of broad categories of technologies validated to different SIAF (Sustainable Intensification Assessment Framework) domain levels is presented in Table 1.

**Table 1:** Broad categories of validated flagship technologies during the past Africa RISING action years

|  |  |
| --- | --- |
| **Broad category** | **Validated flagship technologies** |
| Genetic integration involving introducing new crops and varieties to overcome existing biotic and abiotic stress | Drought-tolerant maize |
| Climbing bean; nutrient-dense beans |
| Stress resistant, high productive groundnut |
| Short-duration pigeon pea |
| Manipulation of crop ecologies to get more crops on limited land and maximize biological nitrogen fixation | Doubled-up food legumes |
| Doubled-up food legumes – mbili mbili spacing |
| Cereal-legume fodder intercropping |
| Grain legume–cereal intercropping and rotations |
| Farm-design crop sequencing |
| Integrated soil fertility management as a cost-effective approach to replenish soil fertility | Optimized fertilizer rates, composts |
| Livestock manure and fertilizer combinations |
| Cover crop composts |
| Introduction of land management technologies to reduce soil loss and enhance water utilization | In situ water harvesting |
| Physical barriers to reduce erosion – ‘fanya juu’, ‘fanya chini’, and shelterbelt |
| Cover crops |
| Conservation agriculture |
| Improved livestock feed quality and quantity | Quality forage and fodder-based feed rations |
| Poultry feeds with vegetable rations and housing |
| Livestock feed with fodder rations |
| Pre- and post-harvest approaches to reduce food waste and improve food safety | Motorized shelling machines, collapsible dryer cases, PICS bags |
| Aflasafe application in maize and groundnut fields |
| Nutrient-rich food crops and improved household nutrition | Recipes for improved child and household nutrition |
| Vegetables |
| Quality protein maize |
| Nutrient fortified beans |
| Orange-fleshed sweet potato |

# Project logframe overview

An overview of the Africa RISING East and Southern Africa Project logframe up to the sub-activity level for the year 2020-2021 can be glanced at from Table 2 below. All sub-activities initiated by project partners align with specific outcomes, outputs, and activities within the logframe. For a detailed look at other important logframe elements like objectively verifiable indicators, sources, and means of verification, the assumptions for each output, etc. the complete project logframe document is accessible at: <https://hdl.handle.net/10568/82852>. Where a sub-activity is missing in the serialization (e.g. 1.1.1.1), it means that the sub-activity was completed in the previous years. The presented ones are either continuing or new sub-activities.

**Table 2:** Logframe overview

|  |  |
| --- | --- |
| **Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability** | |
| Output 1.1: Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies and scaled in Outcomes 4 and 5 | |
| Activity 1.1.1: Assess and iteratively improve resilient crop-crop and crop-livestock integration systems [Assess and iteratively improve crop-livestock combinations from Phase I] | 1.1.1.2 Investigations on the medium to long-term impacts of SI technologies (improved soil fertility management, improved germplasm, crop combinations, nutrient and water management) on crop productivity on multi-locational field sites and baby trials |
| 1.1.1.5: Determining the productivity and resilience benefits of Gliricidia-based cropping systems |
| 1.1.1.6 Assess the uptake and adaptation of new crop configurations- (Mbili Mbili technology)- and understand the influencing factors |
| 1.1.1.8 Exploring the sustainable intensification pathways of farming system case studies in Tanzania and assessing the impact of Africa RISING technologies on resilience |
| 1.1.1.9 Assess the impacts of Africa RISING technologies on the performance and resilience of multi-location and differentially exposed farming systems case studies in Malawi |
| Activity 1.1.2: Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, forages, and livestock | 1.1.2.1 Assessment of the benefits of management technologies on performance of improved vegetable varieties |
| Output 1.2: Demand-driven, labor-saving and gender-sensitive research products to reduce drudgery while increasing labor efficiency in the production cycle piloted for relevant typologies in target areas [and scaled in Outcomes 4 and 5] | |
| Activity 1.2.2 Co-adapt existing mechanization options with target communities | 1.2.2.1 Use of the tractor-mounted ripper tillage implement for enhancing soil water infiltration and moisture conservation in semi-arid areas of Kiteto, Manyara Region Assessment of the benefits of management technologies on performance of improved vegetable varieties (Season 2) |
| Output 1.3: Tools (including ICT-based) and approaches for disseminating recommendations in relation to above research products, integrated in capacity development [and used in Outcomes 4 and 5] | |
| Activity 1.3.1: Conduct extrapolation domain analysis based on GIS, agro-ecology, and crop model-generated information to establish the potential of technologies for geographical reach | 1.3.1.2 Refine regionally relevant extrapolation domain maps for validated conservation agriculture (CA) practices |
| 1.3.1.4 Produce regionally relevant extrapolation domain maps for validated SWC agriculture practices |
| **Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies** | |
| Output 2.1: Demand-driven research products for enhancing soil, land, and water resources management to reduce household/community vulnerability and land degradation piloted in priority agro-ecologies [and scaled in Outcome 5] | |
| Activity 2.1.1: Characterize current practices in ESA through identifying formal and informal arrangements for access to and use of water and land resources | 2.1.1.1 Assessing the buffer and adaptative capacity to harness the resilience of different farm types |
| Output 2.2: Innovative options for land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5] | |
| Activity 2.2.1 Set up demonstration and learning sites in target ESA communities | 2.2.1.2 Investigations on nutrient and water management for climate resilience along a climate gradient in southern Malawi |
| 2.2.1.3 Test climate-smart farming practices (tied ridges, weather-informed varieties, cover crops integration [cowpea, lablab, medium duration pigeon pea]) for increasing productivity of maize-legume system under variable weather conditions |
| 2.2.1.6 Validation of residual tied ridging as a labor-saving technology in semi-arid Areas of Central Tanzania |
| **Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households)** | |
| Output 3.1: Demand-driven research products to reduce post-harvest losses and improve food quality and safety piloted in target areas [and scaled in outcome 5) | |
| Activity 3.1.1 Conduct packaging and delivery of post-harvest technologies through community and development partnerships with iterative review, refining and follow-up | 3.1.1.1 Assess the impact of nutritional messaging on farmers' nutritional knowledge, attitude and practices and household nutrition status, in partnership with Islands of Peace |
| 3.1.1.2 Evaluate the influence of farmer storage structures and environment on the physical and economic losses abatement by hermetic storage devices |
| Output 3.2: Nutritional quality improved through increased accessibility and use of nutrient-dense crops and livestock products | |
| Activity 3.2.1: Promote and deploy nutrient-rich crop varieties and livestock feed resources in target communities | 3.2.1.1. Elucidate pathways to sustainable adoption of nutrient diets and aflatoxin mitigation practices in rural communities of Central Tanzania |
| **Outcome 4: Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved** | |
| Output 4.1: Access to profitable markets for smallholder farming communities and priority value chains facilitated | |
| Activity 4.1.1 Conduct comprehensive value-chain analysis with specific focus on SI technologies | 4.1.1.2 Enhancement of the groundnut seed value chain in central Tanzania: Imperatives for improving functionality |
| 4.1.1.3 Assess how ISFM practices affect farmers’ livelihoods as a result of Africa RISING activities in Babati |
| 4.1.1.4 Assess how livelihoods of farmers are affected by the implementation of ISFM practices as a result of Africa RISING activities in Kongwa |
| 4.1.1.5 Value chain analysis of nutrient-dense common bean varieties in Malawi |
| **Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized** | |
| Output 5.1: Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | |
| Activity 5.1.1: Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations | 5.1.1.1 Continued experimentation in 6 target communities of Eastern Zambia and 9 communities in Central and Southern Malawi with already established clustered CA trials |
| 5.1.1.2 Explore the productivity domains of selected legumes and cereals to elucidate their best fitting cropping system at community/landscape level and their dissemination |
| 5.1.1.4 (a &b) Case-studies: Application of SI technology use among farmers interacting with Africa RISING at different intensities |
| 5.1.1.5 Panel survey, soils processing and meta-analysis studies for maize-grain legumes sequences and implications for sustainability |
| Activity 5.1.2 Use farm trial data to apply crop simulation models (APSIM) and assess performance over space and time, including assessment of climate-smart technologies to establish the potential for adaptation and mitigation | 5.1.2.1 Apply APSIM crop simulation model to assess changes in resource use efficiencies, productivity and profitability of the different cropping systems in Kongwa, Kiteto and Iringa in Tanzania |
| 5.1.2.2 Evaluate the potential contributions of integrated soil-fertility management around the five SIAF domains with emphasis on Africa RISING interventions in Tanzania |
| Activity 5.1.6: Disseminate best-fit integrated crop-livestock technologies to reach and have effect on small-scale farmers in a landscape context | 5.1.6.1 Small-scale piloting of FarmMATCH – a framework for typology-based targeting and scaling of agricultural innovations. (Matching Agricultural Technologies to Farms and their Context) |
| Activity 5.1.7: Conduct cost-benefit and gender analysis coupled with other socio-economic analyses to identify and quantify adoption constraints and opportunities for different farmer contexts | 5.1.7.4 Assess the effect of tied ridging, residual tied and rip tillage on maize productivity, net crop returns, household income and food security |
| Output 5.2: Strategic partnerships with public and private, initiatives for the diffusion, and adoption of research products established | |
| Activity 5.2.2: Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways | 5.2.2.1 Support the Ministry of Agriculture and NGO extension in scaling CA systems in Eastern Zambia and Malawi |
| 5.2.2.3 Partnership with Iles de Paix (IDP) for increasing the adoption of improved vegetable varieties and good agricultural practices (GAP) in vegetable production in 9 new villages in Karatu |
| 5.2.2.7 Partnership with LEAD Foundation to take to scale soil and water management technologies in erosion-prone areas of Central Tanzania |
| Output 5.3: Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners | |
| Activity 5.3.1: Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies | 5.3.1.1 Role of gender from farm-to-fork and the market of grain legumes and dryland cereals in Kiteto and Kongwa (data already collected and partly presented; more in-depth analysis needed) |
| 5.3.1.2 Identify and communicate gender-sensitive decision support tools in the context of different farm typologies |
| 5.3.1.4 Testing an integrated socio-technological approach with household methodologies |
| Output 5.4: A technology adoption, monitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners] | |
| Activity 5.4.1 Monitor and modify the progress of technology adoption process towards scaling | 5.4.1.1 Populate the Beneficiary and Technology Tracking Tool (BTTT) Tanzania, Malawi, and Zambia with information about AR technologies applied, and farmers/households engaged in validating the technologies |
| 5.4.1.2 Populate the technology scaling tool with detailed information on scaling data for Tanzania, Malawi, and Zambia |
| 5.4.1.3 Design simple research rack up database and populate it with research rack up data for Tanzania, Malawi, and Zambia) |
| 5.4.1.4 Conduct data quality assessment (DQA) to verify number of direct beneficiaries reported against those verified in source data for the selected sites |
| 5.4.1.5 Provide additional capacity building and work with ESA research partners to ensure timely (and complete) submission of FTF indicators data, research rack up data, country narratives, IM performance narratives for Fiscal Year 2021, compliance with the AR Data Management Plan (Dataverse data uploading and sharing) |
| 5.4.1.6 Contribute to the development and implementation of learning efforts, documentation and sharing of findings and best practices |

# Planned work

The planned activities are presented in the protocols. Activities under each protocol are aimed at achieving the outputs under the four outcomes in the project logframe (see Table 3).

## Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | | | | | | | |
| a. Output 1.1 | | Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies | | | | | | | | |
| b. Activity 1.1.1 | | Assess and iteratively improve resilient crop-crop and crop-livestock integration systems | | | | | | | | |
| c. Sub-activity 1.1.1.2 | | Investigations on the medium to long term impacts of SI technologies (improved soil fertility management, improved germplasm, crop combinations, nutrient, and water management) on crop productivity on multi-locational field sites and baby trials. | | | | | | | | |
|  | | | | | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | | | Institution | Role | | | | | | |
| Regis Chikowo, Sieg Snapp | | | MSU | PIs, research conceptualization, design, implementation | | | | | | |
|  | | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | | |
|  | |  | | | | | | | | |
| f. Location(s) | | Linthipe, Golomoti, Kandeu, Extension Planning Areas (EPAs) | | | | | | | | |
|  | |  | | | | | | | | |
| g. Start date | | Continue with 4 mother trials in each site that were established between 2012 and 2015 | | | | | | | | |
|  | |  | | | | | | | | |
| h. End date | | December 2021 | | | | | | | | |
|  | |  | | | | | | | | |
| 1. Justification | | | | | | | | | | |
| (See research protocol for details)  Integrating more grain legumes as intercrops or rotational systems can allow farmers to achieve high and stable yields under varying rainfall, with modest fertilizer investments. This is critical for resource-poor farmers who have limited access to mineral fertilizers. In these experiments that were initiated in 2012, we investigate SOC changes over time for treatments that range from an unfertilized control, maize fertilized with NP optimally every year, and when legumes are integrated as intercrops or rotations with maize.  To date, our interventions have resulted in demonstrable knowledge among farmers on sustainable intensification approaches that integrate legumes. For example, we have seen farms that once had little grain legume components, getting diversified, and enabling systematic crop rotations. Recently we have applied stability analysis to assess the impacts of grain legume integration on maize grain yield, yield stability, nitrogen use efficiency (NUE), and ability to meet household protein requirements.  This sub-activity has anchored our action research that has resulted in over 4,000 baby farmers increasing productivity and expanding the area under SI technologies. More details on these experiments are outlined in the following publications: Smith *et al*. 2016[[1]](#footnote-1), Snapp *et al*. 2018 [[2]](#footnote-2), Chimonyo *et al*. 2019[[3]](#footnote-3). This sub-activity presents a rare opportunity to apply SI technologies on-farm for ‘medium to long term’. Thus, there is merit in continuing with these experiments, which are also the basis for the newly introduced systems analysis ‘Case Studies’ sub-activity 5.1.1.4. | | | | | | | | | | |
|  | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | |
| 2.1 To evaluate long-term effects of rotating legumes with maize and other nutrient management options at medium to long term mother trials | | | | | | | | | | |
|  | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | |
| 3.1 Do legume-cereal cropping sequences result in increased labile SOM fractions that largely explain improved efficiencies during the cereal cropping phase? | | | | | | | | | | |
| 3.2 Do cropping sequences that integrate the deep-rooted semi-perennial pigeon pea promote more uniform soil profiles bulk densities and better rooting and nutrient uptake by sequenced crops? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | |
| Experiment design, implementation, and data analysis:  In these experiments that were initiated in 2012, we investigate SOC changes over time for treatments that range from an unfertilized control, maize fertilized with NP optimally every year, and when legumes are integrated as intercrops or rotations with maize. All treatments are replicated three times. The primary data to be collected will be grain yield and biomass productivity. We will harvest on a whole plot basis when farmers are involved in harvesting and participatory evaluation of the technologies or the traditional net–plot harvest in some cases. The protein and calorie production from the various technologies will be used to inform the utility of the technologies regarding the human condition domain.  The N-difference method will be used to estimate biological N2-fixation. Recently we have applied stability analysis to assess the impacts of grain legume integration on maize grain yield, yield stability, nitrogen use efficiency (NUE), and ability to meet household protein requirements. More details on these experiments are outlined in the publications Smith *et al*. 2016[[4]](#footnote-4), Snapp *et al*. 2018[[5]](#footnote-5), Chimonyo *et al*. 2019[[6]](#footnote-6) , and in the Research Protocols 2019-2020. | | | | | | | | | | |
|  | | | | | | | | | | |
| 5. Data (with metrics) to be collected and uploaded on DataVerse | | | | | | | | | | |
|  | | | | | | | | | | |
| **Domain & Indicator** | **Field/plot level metrics** | | **Farm level metrics** | | **Household level metrics** | | **Community/landscape metrics** | **Measurement method** | | **Responsible** |
| Productivity | | | | | | | | | | MSU |
| Maize grain productivity | Maize grain and biomass yield (kg/ha/season); | | Maize production (kg/ha/season) | |  | |  | Yield measurements | | MSU |
| Maize biomass productivity | Legume grain and biomass yield (kg/ha/season | | Maize residue production (kg/ha/season) | |  | |  | Yield measurements | | MSU |
| Legume productivity | Soybean/groundnut grain and biomass yield (kg/ha/season); | |  | |  | |  | Yield measurements | | MSU |
| Yield gap | Yield gap for maize, soybean, groundnuts (kg/ha/season) | |  | |  | |  | Yield measurement | | MSU |
| Economic | | | | | | | | | |  |
| Profitability | Net income ($/crop/ha/season) | |  | |  | |  | Survey | |  |
| Income diversification |  | |  | | Number of income sources | |  | Survey | |  |
| Environmental | | | | | | | | | |  |
| Soil biology | Soil organic carbon (g/kg) | |  | |  | |  | Laboratory testing | | MSU |
| Soil chemical quality | Biological N2-fixation(kg/ha) | | Biological N2-fixation (kg/farm) | |  | |  | Direct measurement | | MSU |
| Human condition | | | | | | | | | | MSU |
| Nutrition | Protein production (g/ha); | |  | |  | |  | Lookup tables | | MSU |
| Food security | Food production  (calories/ha/year) | |  | | Months of food insecurity | |  | Survey | | MSU |
| Social | | | | | | | | | |  |
| Gender equity | Rating of technologies by gender | |  | |  | |  | Participatory evaluation | | MSU |
| Equity (generally) | Capacity (access to information) | |  | |  | |  | Participatory evaluation | |  |
|  | | | | | | | | | | |
| 6. Deliverables | | | | | | Means of verification | | | Delivery date | |
| 6.1 SI field trials established for each site | | | | | | List of field trials, host farmer names available | | | Jan. 2021 | |
| 6.2 Benefits of SI technologies evaluated across sites and documented through a scientific publication | | | | | | Broadening SI options manuscript for ‘Field Crops Research’ published | | | Dec. 2021 | |
| 6.3 At least one field day per EPA conducted | | | | | | Field day reports | | | Jul. 2021 | |
| 6.4 At least one farmer exchange visit conducted | | | | | | Farmer exchange visits reports | | | Aug. 2021 | |
| 6.5 Africa RISING attends at least one DAECC-led district workshop for SI technologies dissemination | | | | | | DAECC meetings and field implementation report | | | Sep. 2021 | |
|  | | | | | | | | | | |
| 7. How will scaling be achieved? | | | | | | | | | | |
| Malawi extension system (District Agricultural Extension Coordinating Committees – DAECC) that has oversite on technology dissemination at the district level will help disseminate technologies in Extension Planning Areas (EPAs) that are not physically reached by the Africa RISING project.  The DAECC constitutes a network that includes the district-level government extension system and all NGOs operating in the district. The composition of the DAECC is dynamic. This body harmonizes agricultural technologies dissemination approaches and improves the efficiency of use/allocation of financial resources by different actors in the different EPAs.  Hold one joint farmer field day in partnership with DAECC. | | | | | | | | | | |
|  | | | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | | | | | |
| Choice crop varieties have been harmonized based on experiences and technical advice from ICRISAT. Increased productivity of grain legumes based on this sub-activity is directly linked to nutrition studies, sub-activity 3.2.2.3 | | | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9. Gantt chart | | 2020 | |  | 2021 | | | | | | | | | |
| Activity/ month | | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Dec |
| 1. Procurement of inputs | |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. IITA –MSU contract/inputs distribution | |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. MSU/partners contracting | |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Establishment of trials/soil sampling (4 mother trials per EPA) | |  |  |  |  |  |  |  |  |  |  |  |  |
| 5. Field assessments/data collection | |  |  |  |  |  |  |  |  |  |  |  |  |
| 6. Fields days (vegetative stage/maturity stage) | |  |  |  |  |  |  |  |  |  |  |  |  |
| 7. Harvesting of trials | |  |  |  |  |  |  |  |  |  |  |  |  |
| 8. post-harvest workshops /feedback meetings | |  |  |  |  |  |  |  |  |  |  |  |  |
| 9. Report writing/publications | |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. DataVerse data upload | |  |  |  |  |  |  |  |  |  |  |  |  |
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| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | | | | | | | | | | | |
| a. Output 1.1 | | | | | Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies | | | | | | | | | |
| b. Activity 1.1.1 | | | | | Assess and iteratively improve resilient crop-crop and crop-livestock integration systems | | | | | | | | | |
| c. Sub-Activity 1.1.1.5 | | | | | Determining the productivity and resilience benefits of Gliricidia-based cropping systems | | | | | | | | | |
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| d. Research team | | | | | | | | | | | | | | |
| Name | | | | Institution | | Role | | | | | | | | |
| Anthony Kimaro | | | | ICRAF | | Leading development of nutritional interaction manuscript and biophysical data processing and analysis, supervise development of other agroforestry publications, and contribute to regional/system-based manuscripts development | | | | | | | | |
| Emmanuel Temu | | | | ICRAF | | Leading processing and analysis adoption and socio-economic data and developing a working paper from these studies | | | | | | | | |
| Julius Manda | | | | IITA | | Contributing to economic analyses of agroforestry technologies | | | | | | | | |
| Anthony Whitbread | | | | ICRISAT | | Coordinating modeling work with ICRAF and within ICRISAT for cross country data sets | | | | | | | | |
| Daniel Mgalla | | | | IITA | | Monitoring of the research activities to ensure compliance with the FtF monitoring system | | | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Students | | | | | | | | | | | | | | |
| Name | | | Institute | | | | | Degree | | | | | Start | End |
| Johannes Hafner | | | Humboldt University, Germany | | | | | Ph.D. (Enhancing Food and Energy Security via Agroforestry) | | | | | 2019 | 2021 |
| Hannah Graef | | | University of Kassel, Germany | | | | | MSc (Organic Agriculture) | | | | | 2020 | 2021 |
|  | | | | | | | | | | | | | | |
| f. Locations | Manyusi, Mlali and Moleti villages in Kongwa District | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start date | October 2015 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| h. End date | September 2021 | | | | | | | | | | | | | |
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| 1. Justification | | | | | | | | | | | | | | |
| Diversification of cropping systems through legume intercropping has the potential to increase agroecosystem resilience and adaptive capacity of farmers through efficient use of growth resources and diversification of production options and income sources. However, there is insufficient evidence for the long-term adaptation benefits of agroforestry systems and the underlying mechanisms in semiarid areas. Accordingly, ICRAF and partners have been testing (under research) and validating (in baby trials) the efficacy of intercropping maize with *Gliricidia sepium* (Jaqua) and/or pigeon pea (*Cajanus cajan* L. Millsp) on soil nutrient and water dynamics and crop productivity as well as assessing the sustainability of this technology using the SIAF framework. Preliminary results on drought resistance indicate that maize-pigeon pea intercropping produces more food on less land under drought and non-drought conditions, without compromising the drought resistance of low input maize systems. This conclusion is supported by higher whole system productivity (Caloric and Protein Yields) and higher land equivalent ratio in the intercropping relative to maize monoculture ([Renwick *et al*. 2020](https://www.frontiersin.org/articles/10.3389/fsufs.2020.562663/full)[[7]](#footnote-7)). A recent meta-analysis of the global dataset also found that crop diversification enhances multiple ecosystem services without compromising crop yields ([Tamburini](https://advances.sciencemag.org/content/6/45/eaba1715.full) *[et al](https://advances.sciencemag.org/content/6/45/eaba1715.full)*[., 2020](https://advances.sciencemag.org/content/6/45/eaba1715.full)[[8]](#footnote-8)).  Our work on drought resistance of *G. sepium* based cropping system has so far focused on induced rainfall effects (Renwick *et al*., 2020), but there is a need to analyze nutritional interactions (facilitative and competitive interactions) which also influence crop productivity in these systems. During the 2020 cropping season, we collected data on nutrient uptake and soil fertility to elucidate the nutritional mechanisms of *G. sepium* and pigeon pea intercropping under fertilization and rainfall gradients. Processing of the data is going on because lab results were delayed. We, therefore, propose to continue with this task in 2021 and publish the results. A new M.Sc. student of the Organic Agriculture at the University of Kassel, Germany has been identified to develop her thesis using part of the data collected. Data on soil fertility and crop yields and nutrient uptake to be processed will also contribute to the analysis of economic benefits and modeling long-term effects of intercropping crop productivity using APSIM. Economic analysis of technologies in the drought resistance experiment is led by Martha Swamila while analysis of socio-economic benefits of farmer-managed demonstration plots is led by Emmanuel Temu. Details of APSIM modeling have been included in the ICRISAT workplan (Sub-activity 5.1.2.1) because they led this component.  We also collected data to assess the process of adoption or dis-adoption and the impacts of agroforestry technologies in the project and scaling sites. This analysis is based on farmer opinions after 3-5 years of implementation and thus it will complement the recent prediction of the adoption potential of agroforestry technologies using ADOPT model ([Swamila](https://www.mdpi.com/2077-0472/10/7/306) *[et al](https://www.mdpi.com/2077-0472/10/7/306)*[., 2020](https://www.mdpi.com/2077-0472/10/7/306)[[9]](#footnote-9)). The model found the following factors to be critical in driving adoption to the peak level: easiness in practicing the technology, the complexity of the technology, the skills and knowledge required, and the initial establishment costs. Critical factors which may cause fluctuations at the peak level (adoption and/or dis-adoption are the establishment costs, environmental benefits (soil fertility, erosion control, etc.), risk mitigation, and profit of agroforestry technology (Swamila *et al*., 2020). Farmers also adopt technologies for other reasons including social status derived from interacting with outsiders and in anticipation of benefits from project personnel (German *et al*., 2006[[10]](#footnote-10)). It is, therefore, necessary to assess the adoption process of technologies after exposure to capture the experience and opinions of farmers in various aspects critical for the success of the technology. These include benefits and/or challenges noted, how farmers adapt the technology demonstrated to them to fit their biophysical and socio-economic contexts, what social network including gender dimensions and market information are necessary for the access and success of the technology, and which impacts the technology has on livelihoods, environment or other components of the farming system. Understanding this kind of information can help researchers in modifying interventions or delivery approaches to be more relevant to the scaling domain ([Coe *et al.*, 2014](https://www.sciencedirect.com/science/article/pii/S1877343513001437)[[11]](#footnote-11)) and in planning future scaling operations (German *et al*., 2006) to minimize uncertainty and risk around the adoption process. Data for this study was collected from farmers and partners in the project sites (Molet, Mlali, and Laikala) and scaling sites of Ngumbi and Kitete Mzindani villages as well as villages under the LEAD foundation-TARI Hombolo collaboration where farmers have shown interest to take up soil and water conservation technologies with trees. | | | | | | | | | | | | | | |
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| 2. Objectives | | | | | | | | | | | | | | |
| 2.1 To assess crop yield, nutrient uptake, and resource use (fertilizer and rainwater) efficiency in *G. sepium* and pigeon pea intercropping in semi-arid areas | | | | | | | | | | | | | | |
| 2.2 To evaluate the profitability of maize-Gliricidia intercropping under semi-arid conditions | | | | | | | | | | | | | | |
| 2.3 To analyze the process of adoption and socio-economic impact of agroforestry technologies within and outside Africa RISING sites to inform future scaling operations | | | | | | | | | | | | | | |
| 2.4. To develop the biomass equation for predicting wood and foliage biomass of *G. sepium* and pigeon pea intercropped with maize. | | | | | | | | | | | | | | |
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| 3. Research questions | | | | | | | | | | | | | | |
| How does intercropping maize with G. sepium and/or pigeonpea in semi-arid areas influence productivity, drought resistance, and resource use efficiency of maize-based systems? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| Experiment design, implementation, and data analysis:  This sub-activity uses data from the maize drought resistance experiment and farmer-managed (demonstrations) trials to complete analysis and develop four new publications and the associated metadata for archiving. Processing of SIAF data on social and human condition domains will also be finalized and archived following the completion of the field survey in September 2020. Details of the experimental design and data collection protocol for the research and farmer-managed trials were provided in the 2019/2020 workplan. They are not reproduced here because no new fieldwork is proposed in 2021.  Progress in developing the new publications and justification for additional resources is provided below[[12]](#footnote-12):   * Nutritional interactions and resource use efficiency (fertilizer and rainwater) in G. sepium and Pigeonpea based intercropping systems under ambient and drought conditions. This is a new manuscript building on the maize drought resistance ([Renwick *et al*., 2020](https://www.frontiersin.org/articles/10.3389/fsufs.2020.562663/full)) to elucidate nutritional mechanisms driving crop productivity. The manuscript will use data on soil fertility, nutrient uptake, and maize and pigeon pea yields after 5-years of intercropping. As described in the last technical report soil fertility and nutrient concentrations data from SUA lab were delayed due to COVID-19 related and have not been processed. The focus in 2021 will be to complete data processing and analysis and develop the manuscript for publication. This is a new manuscript that was not part of the 2020 deliverables. * The profitability of *Gliricidia* intercropping at Manyusi: This is ongoing work to complete the manuscript that was delayed by technical difficulties in modeling *G. sepium* intercropping effects and staff transition at ICRISAT. The manuscript uses data from the drought experiment at Manyusi and the draft is anticipated to be completed by March 2021. The Funds requested are to cover publication costs. * Adoption and socio-economic impacts of agroforestry technologies in Kongwa. This working paper will use data from the adoption study, crop yields, and economic analysis of the farmer-managed demonstrations and the SIAF data on social and human condition domains. The collection of data from demonstration plots and household surveys was delayed by COVID-19 related restrictions to travel and hold meetings. The data was collected towards the end of September 2020 and has not been processed. The proposed manuscript is new and was not part of the 2020 deliverables. * Biomass equation for predicting wood and foliage biomass of *G. sepium* and pigeon pea in intercropping. This is a new manuscript that builds on [Hafner *et al.* (2020)](https://www.sciencedirect.com/science/article/pii/S0973082620303215)[[13]](#footnote-13) to develop a rapid methodology for the assessment of fuelwood from *G. sepium* and pigeon pea intercropping in research and farmer-managed plots based on diameter and height measurements. This non-destructive and rapid assessment of wood production and carbon stock (as 50% of woody biomass) will help to quantify the impacts of large-scale adoption of this promising technology on wood supply and carbon sequestration, given that partners (LEAD Foundation) are actively promoting the technologies. The manuscript will use growth (diameter and height) and wood data collected since 2017 to develop and validate the biomass equation for *G. sepium* and pigeon pea. | | | | | | | | | | | | | | |
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| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | | | | |
| Domain & *Indicator* | | Field/plot level metrics | | | | | Farm level metrics | | | Household level metrics | Community/ landscape metrics | Measurement method | | |
| Productivity | | | | | | | | | | | | | | |
| Input use efficiency | | Yield/input | | | | |  | | |  |  | Derived from yield and input data | | |
| Environmental | | | | | | | | | | | | | | |
| Fuel availability | | Biomass (t/ha) | | | | |  | | | No of energy security months |  | Biomass measurement, household survey | | |
| Soil chemical quality | | Soil nutrient levels (g/kg-soil); nutrient uptake (kg/ha); nutrient use efficiency (kg/uptake) | | | | |  | | |  |  | Laboratory analysis. Derived from data on yield and nutrient concentrations | | |
| Economic | | | | | | | | | | | | | | |
| Profitability | | Gross margin (USD/ha) | | | | |  | | |  |  | Modeling of data on yield and farm operation costs. | | |
| Returns to land | | Returns (USD/ha) | | | | |  | | |  |  | Modeling of data on yield and farm operation costs | | |
| Social | | | | | | | | | | | | | | |
| Gender equity | |  | | | | |  | | |  | Rating of technologies by gender | Participatory evaluation | | |
| Equity | |  | | | | |  | | |  | Rating of technologies by group | Participatory rating | | |
| Human conditions (Data was collected and submitted for uploading on the Dataverse in 2020) | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 6. Deliverables | | | | | | | | | Means of verification | | | | Delivery date | |
| 6.1 Data and manuscript on the nutritional interactions and resource use efficiency (fertilizer and rainwater) in *G. sepium* intercropping | | | | | | | | | Raw data available for uploading on the DataVerse  Draft manuscript verified by the Chief Scientist  Manuscript submitted for publication in a journal | | | | 31 Jan. 2021  30 Jun. 2021  30Sep. 2021 | |
| 6.2 Data and manuscript on profitability of *Gliricidia* intercropping experiment at Manyusi | | | | | | | | | Data available for uploading on the DataVerse  Manuscript verified by the Chief Scientist  Manuscript submitted for publication in a journal | | | | 31 Mar. 2021  30 Apr. 2021  30 Jun. 2021 | |
| 6.3 Data and manuscript on the adoption and socio-economic impacts of agroforestry technologies | | | | | | | | | Raw data available for uploading on the DataVerse.  Manuscript verified by the Chief Scientist  Manuscript published on ICRAF website | | | | 31 Jan. 2021  30 Jun. 2021  30 Sep. 2021 | |
| 6.4 Data and manuscript on the biomass equation for predicting wood and foliage biomass of *G. sepium* and pigeon pea in intercropping | | | | | | | | | Raw data available for uploading on the Dataverse  Draft manuscript verified by the Chief Scientist  Manuscript submitted for publication in a journal | | | | 31 Jan. 2021  30 Jun. 2021  30 Sep. 2021 | |
| 6.5 Twenty thousand seedlings of G. sepium produced and distributed to support scaling of agroforestry LEAD foundation villages | | | | | | | | | Report and list of beneficiaries based on the records from the LEAD foundation and farmer | | | | 30 Jun. 2021 | |
| 6.6 400 flyers on “Productivity and Economic benefits of maize-Gliricidia intercropping” produced in English and Swahili and distributed | | | | | | | | | Photo from nane-nane exhibition booth | | | | Aug. 2021 | |
|  | | | | | | | | | | | | | | |
| 7. How will scaling be achieved? | | | | | | | | | | | | | | |
| ICRAF will partner with the LEAD Foundation, Sustainable Agriculture Tanzania (SAT) and former lead farmers to produce and deliver at least 20,000 *Gliricidia sepium* seedlings to support the scaling of agroforestry technologies in non-Africa RISING sites. ICRAF will show case *G. sepium* intercropping using a demonstration plot at the *Nane-nane* ground in Morogoro (Kilosa district booth) and distribute flyers to participants. | | | | | | | | | | | | | | |
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| 8. How are the activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
| This sub-activity activity is directly linked to the following sub-activities:   * Sub-activity 2.2.1.3: Evaluating potential contributions of integrated soil fertility management around the five SIAF domains with emphasis on Africa RISING interventions in Tanzania: Soil fertility and Economics data to be generated in 2020 will contribute to this system-wide ISFM activity. Also, data on crop and biomass yields for previous seasons are available for this sub-activity. * Sub-activity 5.1.2.1: Apply APSIM crop simulation model to assess changes in resource use efficiencies, productivity, and profitability of the different cropping systems in Kongwa, Kiteto, and Iringa in Tanzania: ICRISAT-Amos; This sub-activity will make use of crop and soil data from Gliricidia-based intercropping experiment to model crop performance in response to resource availability and intercropping options under semiarid conditions in Kongwa. | | | | | | | | | | | | | | |

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| 9. Gantt chart | 2020 | | 2021 | | | | | | | | | |
| Activity/ month | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Pruning of *G. sepium* and site preparation at *Nane-nane* plot |  |  |  |  |  |  |  |  |  |  |  |
| Re-establishment of *Nane-nane* Demonstration plot |  |  |  |  |  |  |  |  |  |  |  |
| Crop management (weeding, fertilizer, disease control) |  |  |  |  |  |  |  |  |  |  |  |
| Data processing, analysis, and archiving |  |  |  |  |  |  |  |  |  |  |  |
| Writing reports and publications (manuscripts, working paper and flyers) |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Project Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | | | |
| a. Output 1.1 | Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies | | | | | |
| b. Activity 1.1.1 | Assess and iteratively improve resilient crop-crop and crop-livestock integration systems | | | | | |
| c. Sub-Activity 1.1.1.6 | Assess the uptake and adaptation of new crop configurations- (Mbili Mbili technology)- and understand the influencing factors  This builds on the activity from last year headed “Assess the yield, economic and BNF benefits of innovative approaches addressing the pigeon pea and common bean productivity within maize-based cropping system and variable weather” | | | | | |
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| d. Research team | | | | | | |
| Name | | Institution | Role | | | |
| Job Kihara | | CIAT | PI | | | |
| Prosper Massawe | | TARI-Selian | Supervise enumerators conducting household surveys and participate in evaluations/assessments and data collection of the test trials | | | |
| Jonas Julius/Rose Anael | | MoA | Organize field days and supervise field operations by farmers | | | |
| Daniel Mgalla | | IITA | Provide support in monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and custom indicators data) with critical gender perspective and uploading into the FtF system | | | |
|  | | | | | | |
| e. Student(s) | | | | | | |
| Name | Institute | | | Degree | Start | End |
| Michael Kinyua | CIAT/Kenyatta University | | | PhD | 2019 | 2022 |
|  | | | | | | |
| f. Location(s) | Seloto, Sabilo, Gallapo in Babati District, Tanzania | | | | | |
|  |  | | | | | |
| g. Start date | January 2020 | | | | | |
|  |  | | | | | |
| h. End date | November 2021 | | | | | |
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| 1. Justification | | | | | | |
| The introduction of new technologies such as the Mbili-Mbili intercropping system has been received positively by farmers and is now tested for 2 seasons with more than 120 babies. The introduction of Mbili-Mbili considered that increasing the productivity of the often-neglected legume component while maintaining the same high yield of maize, is important for overall system economics and household food and nutritional security. An activity was planned during 2019/2020 to understand household social dynamics of the technologies involving a survey and focus group discussions. To take this forward and complement previous activities, it is required to understand the technology uptake and the adaptations done by farmers including the motivation behind these. These are necessary inputs for further refining the practices and also could provide important perspectives for policy. While undertaking this through an in-depth survey involving intervention and control farmers (see experimental design), six of the current on-farm trials will be maintained to continue generating data on the opportunities to maximize the productivity and profitability of the intercropping system, as part of the Ph.D. studies by Michael Kinyua (protocols for this are already available and were submitted in last planning cycle). The trials include CIMMYT tested and proven Meru 513 maize variety with vertical architecture, maize topping, stripping of lower leaves, Mbili-Mbili, and double-up legume technology successfully tested in Malawi. An expanded description of the justification is given in the Research Protocols 2018-2019. The in-depth survey will allow contextualizing technology uptake and extent of use for example due to knowledge access, collective action, etc. | | | | | | |
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| 2. Objectives | | | | | | |
| 2.1. Assessing the uptake and adaptations of Mbili-Mbili technology by farmers in Babati | | | | | | |
| 2.2 Assessing the effects of different crop spatial configurations on the productivity of pigeon pea and beans within in 3 eco-zones of Babati, Tanzania | | | | | | |
|  | | | | | | |
| 3. Research questions | | | | | | |
| 3.1 What contexts and decision variables influence uptake and adaptations of the Mbili-Mbili intercropping system by farmers in Babati? | | | | | | |
| 3.2 What are the effects of different maize-legume spatial configurations on system benefits in 3 eco-zones of Babati, Tanzania? | | | | | | |
|  | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | |
| Experiment design, implementation, and data analysis  A detailed survey will be conducted to understand the uptake and adaptations of the Mbili-Mbili crop configuration systems by farmers. This will target at least 120 farmers including those who have been testing the system in their farms and other farmers from the community with varying degrees of exposure to the Mbili-Mbili technology e.g. via field days and farmer participatory evaluations of technology. An initial draft of the survey tool with key questions is included (appended below) although we expect to review and broaden this to ensure it addresses all aspects intended, based on team inputs. The study will include an equal number of farmers for the different exposure categories and also ensure proper representation of women farmers.    As detailed in our 2019/2020 workplan, the on-farm trials are laid out as a randomized complete block design with 7 maize-legume intercrop treatments. In each field, each treatment is replicated 3 times. Treatment plot sizes are 7m x 5m. The net plot used for measurements of grain and biomass will leave out 1 m from each side of the plot to reduce border effects. Except for one treatment with a 50 x 90 cm maize spacing, two maize seeds will be planted at a spacing of 25 × 75 cm, and later thinned to one, to attain a plant population of 53333 plants per hectare. Pigeon pea and beans are planted to also attain similar densities across plots (i.e., the Mbili-Mbili system has the same pigeon pea density as in other maize-pigeon pea treatments). The research protocol gives details on the treatments, trial design, and data collection and analysis. An expanded description of the design is given in the Research Protocols 2018-2019 attached below. | | | | | | |
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| 5. Data to be collected and uploaded on Dataverse | | | | | | |
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| Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape level metrics | Measurement method (details in research protocol) |
| Productivity | | | | | |
| Crop productivity | Maize, beans, pigeon pea productivity (kg/ha/season) |  |  |  | Yield measurements |
| Variability of production |  |  | Rating of production risk |  | Farmer evaluation |
| Biomass productivity | Maize, beans, pigeon pea biomass productivity (kg/ha/season) |  |  |  | Yield measurements |
| Residue production (kg/ha/season) |  |  |  | Yield measurements |
| Rating of residue production |  |  |  | Farmer evaluation |
| Economic | | | | | |
| profitability | Gross margins ($/crop/ha/ season) |  |  |  | Survey |
| Labor requirement | Labor requirement (hours/ha) |  | Farmer rating of labor |  | Farmer evaluation |
| Variability of profitability |  |  | Probability of low profitability |  | Survey |
| Environmental | | | | | |
| Vegetative cover | % Vegetative cover by type |  |  |  | Remote sensing |
| Fuel availability, soil | Fuel biomass (kg/ha/season) |  |  |  | Survey  Biomass measurement |
| Soil chemical quality | Soil nutrient levels (g/kg) |  |  |  | Soil tests |
| Biological nitrogen fixation  (kg N/ha) |  |  |  | Soil tests |
| Human condition | | | | | |
| Nutrition | Protein production (g/ha) |  |  |  | Lookup tables |
| Food security | Food production (Calories/ha/year) |  | Months of food insecurity; Rating of food security |  | Field measurement/ lookup tables |
| Capacity to experiment |  |  | # of new practices being tested (related to Mbili-Mbili) |  | Survey |
| Social | | | | | |
| Gender equity |  |  | Time allocation by gender |  | Household survey |
|  |  | Management control by gender |  | Household survey |
| Income by gender |  | Income by gender |  | Household survey |
| Rating of technologies by gender |  | Rating of technologies by gender |  | Household survey |
| Food security by gender |  | Food security by gender |  | Household survey |
| Equity (generally) |  |  | Rating of technologies by group |  | Focus group discussions (for farmers hosting trials) |
| Collective action | Participation in a collective action group a |  |  | Collective action groups | Household survey |

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| 6. Deliverables | Means of verification | Delivery date |
| 6.1 Six on-farm trials, 2 in each of 3 eco-zones, successfully implemented | Research reports | Oct. 2021 |
| 6.2 Three new technologies recently introduced tested further | Research reports | Oct. 2021 |
| 6.3 Manuscript of BNF of pigeon pea quantified | Draft Manuscript verified by Chief Scientist | Nov. 2021 |
| 6.4 150 farmers trained (in field days) | Field day reports | Oct. 2021 |
| 6.5 Manuscript on aspects around Mbili-Mbili based on available data | Draft manuscript verified by Chief Scientist | Sept. 2021 |
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| 7. How will scaling be achieved? | | |
| We have developed a field guide that will be a basis of discussions with World Vision and Cosita to potentially scale-out best practices in general. Besides, we will demonstrate the performance of Mbili-Mbili and double-up legume and our new lesson of an ability to produce 2 bean crops during 1 season to these development partners. Already, we presented posters of these technologies during Nane Nane agricultural exhibition. We will also utilize the Mwanga ICT platform to communicate agronomic information. We are partnering with Meru Agro Seed Company to deliver Improved maize seeds and provide advice to farmers. We are also partnering with Minjingu fertilizer company to educate farmers on fertilizer use in production. | | |
|  | | |
| 8. How are the activities in this protocol linked to those of others? | | |
| This study provides data that will feed into farm-level assessments led by Lieven Claessens. Although measured by CIAT, quantities of strippings and toppings link with livestock feed provisioning (ILRI and TALIRI) that again feed into the farm level assessments. Double-up legumes work, also contained in protocols for Kongwa-Kiteto and Malawi, provides an opportunity for cross-site comparisons. | | |

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| 9. Gantt chart | | | | | | | | | | | | |
|  | 2020 | 2021 | | | | | | | | | | |
| Activity/ month | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| Input acquisition, field marking, planting trials, and babies |  |  |  |  |  |  |  |  |  |  |  |
| Co-development of Mwanga messages and messaging |  |  |  |  |  |  |  |  |  |  |  |
| Topdressing |  |  |  |  |  |  |  |  |  |  |  |
| Survey protocol development and pre-testing |  |  |  |  |  |  |  |  |  |  |  |
| Survey implementation and subsequent data analysis |  |  |  |  |  |  |  |  |  |  |  |
| Analysis of survey data |  |  |  |  |  |  |  |  |  |  |  |
| Field days, rating of technologies and bean harvesting, 2nd top dressing |  |  |  |  |  |  |  |  |  |  |  |
| Topping and stripping activities |  |  |  |  |  |  |  |  |  |  |  |
| Maize harvesting, drying, weighing, and sample pre-processing |  |  |  |  |  |  |  |  |  |  |  |
| BNF sampling and phenotypical assessment |  |  |  |  |  |  |  |  |  |  |  |
| Light interception, soil moisture measuring |  |  |  |  |  |  |  |  |  |  |  |
| Weeds and pest disease control |  |  |  |  |  |  |  |  |  |  |  |
| BNF sample pre-processing, shipping, and plant isotope analysis |  |  |  |  |  |  |  |  |  |  |  |
| Pigeon pea harvesting |  |  |  |  |  |  |  |  |  |  |  |
| Litterfall assessment |  |  |  |  |  |  |  |  |  |  |  |
| Seasonal data analysis, Dataverse publishing, and end of year reporting |  |  |  |  |  |  |  |  |  |  |  |
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| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | |
| a. Output 1.1 | Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies [and scaled in Outcomes 4 and 5] | | | |
| b. Activity 1.1.1 | Assess and iteratively improve crop-livestock systems | | | |
| c. Sub-activity 1.1.1.8 | Exploring the sustainable intensification pathways of farming system case studies in Tanzania and assessing the impact of Africa RISING technologies on resilience | | | |
|  |  | | | |
| d. Systems research team | | | | |
| Name | Institution | Role | | |
| Lieven Claessens | IITA | PI, coordination, systems research, SIAF, FarmDESIGN | | |
| Julius Manda | IITA | Economics, 2020 household survey | | |
| Gundula Fischer / consultant | IITA | Social science and gender | | |
| Jeroen Groot | WUR | FarmDESIGN modeling | | |
| All, with past and ongoing activities on farms (see names and roles in protocol) | ICRAF, ICRISAT, WorldVeg, CIAT, CIMMYT, SUA, TARI, TALIRI | Knowledge and data exchange and new experimental data collection (budgeted in their own activities) | | |
|  | | | | |
| e. Student(s): | | | | |
| Name | Institute | Degree | Start | End |
| Eveline Massop | WUR | MSc | October 2020 | May 2021 |
|  | | | | |
| f. Location(s) | Moshi Maile (K/K), Lukumay (Babati), Monica Pascale (Babati) | | | |
|  | | | | |
| g. Start date | October 2018 | | | |
|  | | | | |
| h. End date | September 2021 | | | |
|  | | | | |
| 1. Justification | | | | |
| In the course of the Africa RISING project, farmers in the targeted agro-ecologies have been exposed to and involved in research and experimentation on improving crop-livestock systems (e.g., mother trials). There are a few examples of very successful farmers who benefited from the (stepwise) introduction of AR technologies on their farms. It would be useful to assess their pathway to sustainable intensification from a systems perspective, also to learn lessons for scaling potential. The Sustainable Intensification Assessment Framework (SIAF, [www.sitoolkit.com](http://www.sitoolkit.com)) provides a useful tool for assessing the farming systems across multiple domains and scales and to identify synergies and tradeoffs. In addition, the FarmDESIGN modeling framework (e.g., Groot *et al.,* 2012[[14]](#footnote-14)) provides a useful tool to analyze the multiple interactions between farm components (resource flows) and will be used to quantify and verify the sustainable intensification pathways experienced on the farms. We identified 3 farms in Tanzania where AR researchers have been working for multiple years and where some data are available. During 2020, we have complemented the available data with detailed interviews (2 out of 3 farms) and a household survey (focusing on the adoption of post-harvest technologies) in which the 3 farms were included.  For the FarmDESIGN analysis, data could not be collected in the period foreseen (covid-19). Therefore, it was decided to select two alternative but similar farms from the ARBES database (1 in Kongwa, 1 in Babati) and apply the FarmDESIGN methodology exploring farm performance under different scenarios (baseline- AfricaRISING technologies-price and drought shock scenarios). This year, and with the new data available, we plan a similar analysis for the 3 farms that were originally selected. | | | | |
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| 2. Objectives | | | | |
| Exploring the sustainable intensification pathways of farming system case studies in Tanzania and assessing the impact of Africa RISING technologies on resilience | | | | |
|  | | | | |
| 3. Research questions | | | | |
| * What are the key steps involved in a sustainably intensified integrated crop-livestock farming system? * How are different interventions interacting and complementing or enhancing each other? * How do farming systems perform according to SIAF and the FarmDESIGN model? * How do farming systems perform when subjected to scenarios of shocks? * What is the contribution of Africa RISING technologies to resilience (recovery from shocks)? * What are the perceptions and experiences of multiple members of the targeted farm households with increased intensification? What are their motivations to embark on the change process? * How can we describe the decision-making processes and labor arrangements of men and women living in these households? * What are their roles in the communities? How/how far do they inform scaling potential? | | | | |
|  | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis  This is not an experiment, rather a study design. The activity is being implemented by conducting in-depth interviews and participatory exercises with the farmers (e.g. life story interviews, linkage diagrams), collating and scrutinizing existing data from researchers active on the sites and the 2020 household survey, collecting new data to fill the gaps for SIAF, FarmDESIGN and overseeing new data collection in the case of ongoing experimentation by partners. | | | | |
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| 5. Data (with metrics) to be collected and uploaded on Dataverse | | | | |
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| Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method |
| Productivity | | | | | |
| Crop grain productivity (maize, pigeon pea, groundnut, vegetables) | kg/ha/season | kg/ha/season |  |  | Yield measurements |
| Crop biomass productivity (maize, pigeon pea, groundnut, vegetables) | kg/ha/season | kg/ha/season |  |  | Yield measurements |
| Livestock productivity | Animal products (amt./animal/yr.)  Animal by-products (amt./animal/yr.) | Animal product per unit land (amt./ha/yr) Animal byproduct per unit land (amt. /ha /yr) |  |  | Yield measurements |
| Variability of production | CV | CV |  |  | Calculated if multiple year data available |
| Economic | | | | | |
| Profitability | Net income ($/crop/ha/season)  Gross margin | Net income (total net income for all farm activities)  Gross margin |  |  | Household survey |
| Poverty |  |  | Asset index |  | Household survey |
| Labor requirements | Labor requirement (hours/ha) | Labor requirement (hours/ha) |  |  | Household survey |
| Market participation |  |  | % production sold |  | Household survey |
| Environmental | | | | | |
| Soil chemical quality | Soil nutrient levels | Nutrient partial balance |  |  | Soil analysis |
| Erosion | Soil loss (tons/ha/yr) |  |  |  | Modeling? |
| Social | | | | | |
| Collective action | Participation in a collective action group | Participation in a collective action group | Participation in a collective action group | Collective action groups | Household survey |
| Gender equity | Household decision-making and labor arrangements | Household decision-making and labor arrangements | Household decision-making and labor arrangements |  | Household survey |
| Human | | | | | |
| Food security | Food production (Calories/ha/year) | Food production (Calories/ha/year) | Months of food insecurity |  | Calculated & household survey |
| Nutrition | Protein production (g/ha) Micronutrient production (g/ha) | Total protein production (g/ha)  Total micronutrient production (g/ha) | Access to nutritious foods |  | Calculated & household survey |
| Capacity to experiment |  |  | # of new practices being tested |  | Household survey |

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| 6. Deliverables | Means of verification | Delivery date |
| Data from the 2020 household survey processed and exchanged among team | Email exchanges | Jan. 2021 |
| Remaining interviews with farmers conducted by a consultant | Report, recording, and transcriptions | Mar. 2021 |
| Farming systems analyzed with SIAF and FarmDESIGN | Report/MSc thesis | May 2021 |
| Sustainable intensification pathways and impact of AfricaRISING technologies on resilience to shocks assessed and documented | Draft journal article verified by Chief Scientist | Jun. 2021 |

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| 7. How will scaling be achieved? |
| NA. This work is being conducted for the understanding of farming systems and is not a technology for scaling. |
|  |
| 8. How are the activities in this protocol linked to those of others? |
| This sub-activity is linked to all sub-activities with active experimentation and data collection on the 3 selected farms. |

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| 9. Gannt chart combined for | 2020 | | | 2021 | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Preparation of workplans and study designs with partners, collation of existing data |  |  |  |  |  |  |  |  |  |  |  |  |
| (Online) meetings with project team members |  |  |  |  |  |  |  |  |  |  |  |  |
| Planting of trials (by partners)? |  |  |  |  |  |  |  |  |  |  |  |  |
| Management of trials (by partners)? |  |  |  |  |  |  |  |  |  |  |  |  |
| Additional data collection (`biophysical and socio-economic) |  |  |  |  |  |  |  |  |  |  |  |  |
| Data processing and analysis |  |  |  |  |  |  |  |  |  |  |  |  |
| Preparation of reports and publications |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | | | | |
| a. Output 1.1 | Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies [and scaled in Outcomes 4 and 5] | | | | | | |
| b. Activity 1.1.1 | Assess and iteratively improve crop-livestock systems | | | | | | |
| c. Sub-activity 1.1.1.9 | Assess the impacts of Africa RISING technologies on the performance and resilience of multi-location and differentially exposed farming systems case studies in Malawi | | | | | | |
|  |  | | | | | | |
| d. Systems research team | | | | | | | |
| Name | Institution | Role | | | | | |
| Lieven Claessens | IITA | PI, coordination, systems research, SIAF, FarmDESIGN, MSc student supervision | | | | | |
| Regis Chikowo, Sieg Snapp | MSU | Implementation and supervision in Malawi | | | | | |
| Christian Thierfelder, Mutenje Munyaradzi | CIMMYT | Implementation and supervision in Malawi | | | | | |
| Julius Manda | IITA | Economics | | | | | |
| Jeroen Groot | WUR | FarmDESIGN modeling, MSc student supervision | | | | | |
|  | | | | | | | |
| e. Student(s): | | | | | | | |
| Name | Institute | Degree | | Start | | End | |
| Madeline Mathews | UvA/WUR | MSc | | November 2020 | | June 2021 | |
|  |  | | | | | | |
| f. Location(s) | Linthipe, Kandeu, Golomoti, Balaka, Zomba | | | | | | |
|  |  | | | | | | |
| g. Start date | October 2020 | | | | | | |
|  |  | | | | | | |
| h. End date | September 2021 | | | | | | |
|  | | | | | | | |
| 1. Justification | | | | | | | |
| This sub-activity is building on the long-term activities that AfricaRISING researchers have been conducting in central Malawi. The MSU-led component started interacting with farmers during the 2012/13 cropping season in three agro-ecologies in central Malawi. CIMMYT started interacting with farmers that have been using CA-based SI technologies since the 2007/2008 cropping season in three agro-ecologies in central Malawi. Farmers were primarily engaged at different levels:   * Mother trial farmers: these are farmers who hosted fully replicated trials with a range of technologies, often more than 8 treatments. They are a nucleus group of farmers, who anchor the learning process. They are more visited by researchers and often host field days. Farmer interaction with researchers and extension is rated as ‘high’. * Mother trial farmer experimenter: these are the same host farmers who are applying SI technologies on their wider farm. * Baby farmers: These are a selected group of farmers who are associated with a mother trial. These farmers usually participate in field days and engage extension staff. * Local controls: These farmers are located in the same village as the mother and baby trial farmers. They do not directly benefit from Africa RISING but are exposed to Africa RISING technologies through field days. They often do not directly relate to the project.   In an activity that started in 2020, it was hypothesized that crop productivity on mother trials typically represents water-limited yield potential for the different agro-ecologies. These crop yields would be used as benchmarks to assess the level of intensification at farm-scale for the three other farmers’ groups (II, III, and IV). Mother trial farmers are more likely to adopt more technologies as they more closely interact with a range of SI technologies on the mother trials. In 2020, data collection had started on a sample of farms in the different categories, but this was unfortunately interrupted by covid-19. We propose to build on the available data (and repeat data collection in 2021) to conduct a whole-farm systems analysis with the FarmDESIGN modeling framework (e.g., Groot *et al*., 2012[[15]](#footnote-15)). This model provides a useful tool to analyze the multiple interactions between farm components (resource flows) and will be used to quantify and verify the sustainable intensification pathways experienced by the different farm categories. The model can also be used to assess the resilience to shocks and how this can be attributed to different levels of SI. | | | | | | | |
|  | | | | | | | |
| 2. Objectives | | | | | | | |
| Assessing the impacts of AfricaRISING technologies on the performance and resilience of multi-location and differentially exposed farming systems case studies in Malawi | | | | | | | |
|  | | | | | | | |
| 3. Research questions | | | | | | | |
| * What is the adoption and impact of SI technologies for differentially exposed farming systems (mother trial host farmers, baby trial farmers, and farmers not directly participating in Africa RISING activities)? * How do the different farming systems perform when subjected to scenarios of shocks? * What is the contribution of AfricaRISING technologies to resilience to shocks)? | | | | | | | |
|  | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | |
| Experiment design, implementation, and data analysis  This is not an experiment, but an analysis building on data from medium to long-term trials. The bulk of data collection was done in 2020 but additional data collection is foreseen in 2021. Survey instruments and data collection protocols are available. | | | | | | | |
|  | | | | | | | |
| 5. Data (with metrics) to be collected and uploaded on Dataverse   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method | | Productivity | | | | | | | Crop grain productivity (maize, pigeon pea, groundnut, vegetables) | kg/ha/season | kg/ha/season |  |  | Yield measurements | | Crop biomass productivity (maize, pigeo pea, groundnut, vegetables) | kg/ha/season | kg/ha/season |  |  | Yield measurements | | Livestock productivity | Animal products (amt./animal/yr.)  Animal by-products (amt./animal/yr.) | Animal product per unit land (amt./ha/yr) Animal byproduct per unit land (amt. /ha /yr) |  |  | Yield measurements | | Variability of production | CV | CV |  |  | Calculated if multiple year data available | | Economic | | | | | | | Profitability | Net income ($/crop/ha/season)  Gross margin | Net income (total net income for all farm activities)  Gross margin |  |  | Household survey | | Poverty |  |  | Asset index |  | Household survey | | Labor requirements | Labor requirement (hours/ha) | Labor requirement (hours/ha) |  |  | Household survey | | Market participation |  |  | % production sold |  | Household survey | | Environmental | | | | | | | Soil chemical quality | Soil nutrient levels | Nutrient partial balance |  |  | Soil analysis | | Erosion | Soil loss (tons/ha/yr) |  |  |  | Modeling? | | Social | | | | | | | Collective action | Participation in a collective action group | Participation in a collective action group | Participation in a collective action group | Collective action groups | Household survey | | Gender equity | Household decision-making and labor arrangements | Household decision-making and labor arrangements | Household decision-making and labor arrangements |  | Household survey | | Human | | | | | | | Food security | Food production (Calories/ha/year) | Food production (Calories/ha/year) | Months of food insecurity |  | Calculated & household survey | | Nutrition | Protein production (g/ha) Micronutrient production (g/ha) | Total protein production (g/ha)  Total micronutrient production (g/ha) | Access to nutritious foods |  | Calculated & household survey | | Capacity to experiment |  |  | # of new practices being tested |  | Household survey | | | | | | | | |
|  | | | | | | | |
| 6. Deliverables | | | | | Means of verification | | End date |
| Data from 2020 surveys processed and exchanged among team | | | | | Email exchanges | | Jan. 2021 |
| Missing data (mainly on yields) collected | | | | | Report, database | | Mar. 2021 |
| Farming systems analyzed with FarmDESIGN | | | | | Report/MSc thesis | | May 2021 |
| Adoption and impact of SI technologies for differentially exposed farming systems assessed and documented | | | | | Draft journal article verified by Chief Scientist | | Jun. 2021 |
|  | | | | | | | | |
| 7. How will scaling be achieved | | | | | | | | |
| NA. This work is being conducted for the understanding of farming systems and is not a technology for scaling. However, there is a scaling component, based on the results of the analyses, planned in sub-activity 5.1.1.4 (Case studies: Application of SI technologies use among farmers interacting with Africa RISING at different intensities). | | | | | | | | |
|  | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | | | |
| This sub-activity is linked to ongoing sub-activity 5.1.1.4 in Malawi (Case studies: Application of SI technologies use among farmers interacting with Africa RISING at different intensities). | | | | | | | | |
|  | | | | | | | | |
| 9. Budget (combined for sub-activity 1.1.1.8 and 1.1.1.9) | | | | | | | | |
| Budget line | | | IITA | | | | | |
| Personnel | | |  | | | | | |
| Consultant for G. Fischer (cc5840) | | | 650 | | | | | |
| Research assistant for survey data cleaning and extraction | | | 350 | | | | | |
| Operational budget | | |  | | | | | |
| Program/ project travel | | | NA (we were instructed not to budget for this travel | | | | | |
| Research Travel: in-country travel to field sites in TZ | | | 2,000 | | | | | |
| Research Travel: international travel (Malawi, Netherlands) | | | 6,000 | | | | | |
| Data collection and analysis support (WUR, Jeroen, and MSc students) | | | 1,000 | | | | | |
| Dissemination | | |  | | | | | |
| Conference registration & attendance | | | 3,000 | | | | | |
| Open access fees | | | 2,500 | | | | | |
| Total | | | 15,500 | | | | | |

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| 10. Gannt chart combined | | | | | | | | | | | | | |
|  | 2020 | | | 2021 | | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Preparation of workplans and study designs with partners, collation of existing data |  |  |  |  |  |  |  |  |  |  |  |  |
| (Online) meetings with project team members |  |  |  |  |  |  |  |  |  |  |  |  |
| Planting of trials (by partners)? |  |  |  |  |  |  |  |  |  |  |  |  |
| Management of trials (by partners)? |  |  |  |  |  |  |  |  |  |  |  |  |
| Additional data collection (`biophysical and socio-economic) |  |  |  |  |  |  |  |  |  |  |  |  |
| Data processing and analysis |  |  |  |  |  |  |  |  |  |  |  |  |
| Preparation of reports and publications |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, profitable, and sustainably intensified crop-livestock systems linked to markets | | | | | |
| a. Output 1.1 | | Demand-driven, climate-smart, integrated crop-livestock research products (contextualized technologies) for improved productivity, diversified diets, and higher income piloted for specific typologies in target agro-ecologies and scaled in Outcomes 4 and 5 | | | |
| b. Activity: 1.1.2 | | Evaluate and implement pathways that are effective at improving access to seeds and clonal materials of modern varieties of legumes, cereals, vegetables, forages and livestock | | | |
| c. Sub-activity 1.1.2.1 | | Assessment of the benefits of management technologies on performance of improved vegetable varieties (Season 2) | | | |
|  | | | | | |
| d. Research team: | | | | | |
| Name | Institution | | Role | | |
| Sognigbe N’Danikou | WorldVeg | | PI | | |
| Ludovic Joly | Iles de Paix (IDP) | | To support scaling of vegetable technologies and fund nutrition activities in 8 new villages | | |
| NN | IITA/IFPRI | | M&E support | | |
|  | | | | | |
| e. Student(s):Nil | | | | | |
|  | | | | | |
| f. Location(s) | 8 Villages in Karatu District, Tanzania: Kambi ya samba, Bashay, Buger, Gyekrumlambo, Slahhamo, Rhotia Kainam, Chem, Changarawe plus new 9 villages). | | | | |
|  |  | | | | |
| g. Start date | January 2019 | | | | |
|  |  | | | | |
| h. End date | 31 March 2021 | | | | |
|  | | | | | |
| 1. Justification | | | | | |
| Vegetables are valuable sources of energy, micronutrients, and income generation for the rural and urban population. Traditional vegetables are particularly important for providing micronutrients and are well adapted to harsh climatic conditions and diseases infestation and are easier to grow. However, low production per unit area is the major challenge. The declining yield of vegetables is a result of poor farming practices such as the use of poor-quality seeds, poorly sown and managed seedlings and inadequate application of manures, limited water for production, misuse, and abuse of inorganic fertilizers, and rampant use of pesticides. Improved management practices (IM), combines with technological packages of good quality improved seed varieties, healthy seedlings, good agronomic practices (GAPs), can potentially provide pathways out of hunger and poverty. WorldVeg will introduce three improved varieties of vegetables: tomato and traditional vegetables (African eggplant and Ethiopian mustard). The current research is based on the premise that growing improved vegetable varieties should be combined with improved and safer practices that will contribute to more diverse, healthier, and balanced diets while also increasing farm household income.  Farmers acknowledged and appreciated the training on IPM (Insect traps, making biopesticides, etc.) and production practices such as line sowing, making of compost manure, fertilizer application, and installing an irrigation system. Therefore, in the second season, these two activities will be implemented again in 9 villages to validate the results of the first season | | | | | |
|  | | | | | |
| 2. Objectives | | | | | |
| 2.1 To assess the impact of improved management practices (improve varieties and good agricultural practices) on yield, reduction of insect pests, and profitability of growing different vegetables (e.g. African nightshade, tomato, and Ethiopian mustard). | | | | | |
| 2.2 To analyze the impact of improved management practices at the farm level through a case study of two farmers who will be selected in the already hosting villages. | | | | | |
|  | | | | | |
| 3. Research questions | | | | | |
| What is the impact of improved management practices on vegetable pests, yield, and profits? | | | | | |
|  | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | |
| Experiment design, implementation, and data analysis:  The study will follow an on-farm participatory research approach. The research trial will be a Randomized Complete Block Design (RCBD) which makes it easy to conduct experiments with farmers. The treatments will include 3 improved crop varieties X management (+/- improved management practices). An expanded description of the design is given in the research protocol (attached). | | | | | |
|  | | | | | |
| 5. Data (with indicators and metrics) to be collected and uploaded on Dataverse | | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method | | Productivity | | | | | | | Vegetable productivity | Kg/ha/season | Kg/ha/season | - | Rating of yields - | Yield measurement  Farmer evaluation | | Post-harvest loss | - | - | % of harvest lost | - | Direct measurements | | Economic | | | | | | | Profitability | Gross margin ($/crop/ha/ season) | Gross margin ($/crop/ha/season) | Gross margin ($/crop/ha/season) | - | Direct measurements | | Market participation | - | - | % production sold | Total sales | Direct measurements | | Input intensity | - | Input/ha/season | Input/ha/season | - | Direct measurements | | Environmental | | | | | | | Pesticide use | * Active ingredient applied (kg/ha) | * Active ingredient applied (kg/ha) | * - | - | Direct measurements | | Pest levels | Pest abundance and  severity by type | - | - | - | Seasonal transects | | Human Condition | | | | | | | Nutrition | - | - | Access to nutritious vegetables (no. of veg. consumed) | - | Survey | |  |  | Amount consumed (g/day) | % of households consuming below minimum | | Social | | | | | | | Gender equity | Rating of technologies by gender | Rating of technologies by gender | Rating of technologies by gender | - | Focus group discussions (FGD) | |  | Market participation by gender | Market participation by gender | Market participation by gender | - | FGD/Survey | | | | | | |
|  | | | | | |
| 6. Deliverables: | | | | Means of verification | Delivery date |
| Season 2 data on the impact of improved management practices on vegetable production collected. | | | | Data set (in data verse) | Feb. 2021 |
| Impact of improved management practices | | | | Draft paper verified by Chief Scientist | Mar. 2021 |
| 1 Farmer field day conducted | | | | Farmer field day reports | Dec. 2020 |
| At least 1 success/blog story | | | | Success story submitted to Africa RISING Comms. | Mar. 2021 |
|  | | | | | |
| 7. How will scaling be achieved? | | | | | |
| Islands of Peace (IDP), an NGO in Karatu District, will scale the technologies to additional new nine villages with an estimated membership of 350 households within Karatu district and to other regions where they are conducting development activities (see sub-activity 5.2.2.3). | | | | | |
|  | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | |
| Improved vegetable varieties and good agronomic practices for new traditional African vegetables (TAV) are being scaled by IDP (sub-activity 5.2.2.3). The Livestock component of the ESA Project is utilizing vegetable wastes to prepare feed rations: “Sub-Activity 5.1.4.2: Demonstrate the effect of home-made feed rations based on Gliricidia sepium and vegetable waste on productivity of selected strains of chickens”. | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9. Gantt chart | | 2020 | | | | | | 2021 | | |
| Activity/ month | | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
| Introduction and promotion of improved varieties and good agricultural practices (GAP) in new and old villages (Lead-WorldVeg) | Good agricultural practices (GAP) and IPM practices |  |  |  |  |  |  |  |  |  |
| Proper harvesting and post-harvest principles and technologies |  |  |  |  |  |  |  |  |  |
| Data collection/seasonal transects/FGD |  |  |  |  |  |  |  |  |  |
| Community empowerment (Lead: WorldVeg) | 1 Field day |  |  |  |  |  |  |  |  |  |
| Backstopping IDP to scale improved management practice in new villages (Lead: IDP) | Participate in awareness creation (vegetable farming as a business (value chain thinking) |  |  |  |  |  |  |  |  |  |
| Train IDP staff how to effectively scale out the improved technologies |  |  |  |  |  |  |  |  |  |
| Nutrition training in new villages (Lead: WorldVeg) | Nutrition message training |  |  |  |  |  |  |  |  |  |
| Train food kiosks on recipe preparation and evaluate recipe acceptability |  |  |  |  |  |  |  |  |  |
| Focus groups discussions and Key informant interviews (KII) to assess collective action activities |  |  |  |  |  |  |  |  |  |
|  | Survey/FGD to assess/monitor the uptake of nutritious recipes |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | |
| a. Output 1.2 | Demand-driven, labor-saving and gender-sensitive research products to reduce drudgery while increasing labor efficiency in the production cycle piloted for relevant typologies in target areas [and scaled in Outcomes 4 and 5] | | | |
| b. Activity 1.2.2 | Co-adapt existing mechanization options with target communities | | | |
| c. Sub-activity 1.2.2.1 | Use of the tractor-mounted ripper tillage implement for enhancing soil water infiltration and moisture conservation in semi-arid areas of Kiteto, Manyara Region | | | |
|  | | | | |
| d. Research team | | | | |
| Name | Institution | Role | | |
| Elirehema Swai | TARI Hombolo | PI – Overall coordination and production of manuscript on crop and soil water variables | | |
| Gundula Fischer | IITA | Preparation of the gender section of the manuscript | | |
| Julius Manda | IITA | Providing technical backstopping on the economic section of the manuscript | | |
| Lutengano Edward Mwinuka | University of Dodoma | Data analysis and preparation of the economic section of the manuscript | | |
| Emanuel Mbazi Msemo | SUA | Providing expertise on long-term data analysis | | |
|  | | | | |
| e. Student (s): Nil | | | | |
|  | | | | |
| f. Location | Kiperesa, Kiteto District | | | |
|  | | | | |
| g. Start date | 2016/2017 | | | |
|  | | | | |
| h. End date | Sep. 2021 | | | |
|  | | | | |
| 1. Justification | | | | |
| In the semi-arid areas of Kiteto District in Manyara Region, more than 65% of smallholder farmers are using tractor-mounted disc plows for primary tillage (https://cgspace.cgiar.org/handle/10568/16883). Conversely, more than 50% of smallholder farmers in Kongwa District rely mostly on the use of oxen-drawn mouldboard plow. In the 2015/2016 cropping season, the use of tractor-mounted ripper was introduced in Kiteto District to address the challenges associated with plow layer hardpan which restricts the movement of soil water. The productivity performance of rip tillage using tractor-mounted was evaluated during the 2016/2017 season in Njoro and Kiperesa villages as a sound strategy for increasing resilience to climate variability and change. Performance of maize increased by over 30%. Over the last two cropping seasons, i.e., 2018/2019 and 2019/2020, information related to the economic, human condition, and social domains have been collected. Therefore, during 2020/2021, the team will analyze the data collected during 2016/2017 to 2019/2020 cropping seasons to quantify the benefits of the rip tillage technique according to the sustainable intensification framework. | | | | |
|  | | | | |
| 2. Objective | | | | |
| 2.1 To determine the benefits of rip tillage in semi-arid agro-ecologies of Central Tanzania in the face of climate variability in the economic, environmental, human and social SI domains. | | | | |
|  | | | | |
| 3. Research question | | | | |
| 3.1 What are the economic benefits of rip tillage in terms of profitability and labor requirements? | | | | |
| 3.2 How does rip tillage improve soil water availability for crop production in water stress periods? | | | | |
| 3.3 How much can calorie production be increased by rip tillage compared to conventional plowing in situations of rain-water shortage? | | | | |
| 3.4 How does rip tillage influence gender roles? | | | | |
|  | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis  The study consisted of one researcher-managed factorial experiment with two tillage treatments (conventional farmer practice – CFP, and rip tillage – RT) and two improved maize varieties (a commercial variety & a drought-tolerant variety), which gave a total of four treatment combinations. In addition, 10 farmers were randomly selected across the village each constituted a replication by hosting a complete set of treatments. All treatments received 20kg P/ha and 18kg N/ha as Diammonium Phosphate (DAP) fertilizer at planting and (40kg N/ha) as Urea fertilizer was applied as a topdressing.  4.1 Data analysis:   * Biophysical variables: Analysis of variance for biophysical variables collected during 2016/2017 to 2019/2020 cropping seasons namely crop growth/yield, hydrological and physical variables will be run using Genstat software. * Food security: Food security parameters will be estimated by converting maize grain yield per hectare in all treatments to calories produced per hectare using published constant conversion factors of dry grain weight to calories as well as protein specific to Tanzania (Lukmanji et al., 2008)[[16]](#footnote-16). * Gender analysis: The two MSc students from Dodoma University were involved in collecting the information on gender under the supervision of the gender expert from IITA. Thus, key findings noted are expected to be shared. * Economic analysis: To quantify the profitability of using rip tillage technology the Gross margin ($/ha) method will be used. | | | | |
|  | | | | |
| 5. Data collected and uploaded on DataVerse: No new data will be collected | | | | |
|  | | | | |
| 6. Deliverables | | | Means of verification | Delivery date |
| 6.1 First draft of manuscript on the use of tractor-mounted ripper tillage implements for enhancing soil water infiltration and moisture conservation in semi-arid areas of Kiteto | | | Manuscript shared with co-authors and chief scientist | Apr. 2021 |
| 6.2 Second draft with incorporation comments received from internal reviewers | | | Confirmation of submission from journal | Jun. 2021 |
| 6.3 Final manuscript ready for publication | | | Final submission to journal | Aug. 2021 |
|  | | | | |

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| 7. How will scaling be achieved? Not applicable |
|  |
| 8. How are the activities in this protocol linked to those of others? |
| The rip tillage technology was validated with improved maize varieties, notably one drought-tolerant (DT) maize variety released recently under the ongoing Water Efficient Maize for Africa (WEMA) Project in Tanzania and one commercial maize variety commonly used in the area, namely DKC 9089. The sub-activity is linked to sub-activity 4.1.1.4 which concerns assessing the effect of tied ridging, residual tied and rip tillage on maize productivity, net crop returns, household income, and food security. It was also linked to sub-activity 1.2.2.2: Gender analysis of soil and water conservation technologies which generated data/information addressing the social domain component. |

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| 9. Gantt chart | 2021 | | | | | | | | |
| Activity/ month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Team members share their views on the setup of the paper with consideration of SIAF |  |  |  |  |  |  |  |  |  |
| Consultation of a statistician on the analysis of long-term data collected |  |  |  |  |  |  |  |  |  |
| Draft manuscript and share with co-authors and CS |  |  |  |  |  |  |  |  |  |
| Incorporation of comments received from internal reviewers |  |  |  |  |  |  |  |  |  |
| Submission of the manuscript to selected journal |  |  |  |  |  |  |  |  |  |
| Edit peer-reviewed manuscript for publication |  |  |  |  |  |  |  |  |  |

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| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | | | | | | | |
| a. Output: 1.3 | | Tools (including ICT-based) and approaches for disseminating recommendations in relation to above research products, integrated in capacity development | | | | | | | | |
| b. Activity: 1.3.1 | | Conduct extrapolation domain analysis based on GIS, agro-ecology, and crop model-generated information to establish the potential of technologies for geographical reach | | | | | | | | |
| c. Sub-activity: 1.3.1.2 | | Refine regionally relevant extrapolation domain maps for validated conservation agriculture (CA) practices | | | | | | | | |
|  | | | | | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | Institution | | | Role | | | | | | |
| Francis Muthoni | IITA | | | PI | | | | | | |
| Christian Thierfelder | CYMMYT | | | Provide agronomic data on CA technologies | | | | | | |
|  | | | | | | | | | | |
| e. Student(s) | | | | | | | | | | |
| Name | | | Institute | | | Degree | | Start | End | |
| Vacancy | | | TBD | | | MSc. | | Jan. 2021 | Sep. 2021 | |
|  | | | | | | | | | | |
| f. Location(s) | Malawi, Zambia, ESA Region | | | | | | | | | |
|  | | | | | | | | | | |
| g. Start | Sept 2018 | | | | | | | | | |
|  | | | | | | | | | | |
| h. End | Sept 2021 | | | | | | | | | |
|  | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | |
| Recent research has demonstrated the benefits of conservation agriculture (CA) practices on improving the sustainability and productivity of farming systems in Zambia and Malawi. However, the rates of adoption of CA practices remain low, partly due to poor spatial targeting. Therefore, we will start Identifying which CA system offers yield and sustainability advantages over conventional tillage practices (CP) at specific locations. The information will help to refine the recommendation domains of different CA systems for better spatial targeting. During the 2019 - 2020 season, extrapolation domains for conservation agriculture practices in maize-based systems in Southern Africa were generated for the season with below (2005) and above (2017) average precipitation. A machine learning model (ML), based on Random Forests (RF) algorithm and random cross-validation, was applied for spatial predictions of maize yields from CA and CP systems. The model was calibrated with 13 years of on-farm trials and 29 remote sensing derived grid rasters. The model showed high accuracy (R2 = 0.63, RMSE = 1.3 t/ha). The predictions examined the yield advantages from CA systems during two seasons with below and above season precipitation. The yield advantages from CA systems covered a larger area during drought compared to wetter season. Recently, new agronomic data was obtained from CIMMYT covering the 2007 – 2020 growing seasons. The plan for the next season is to extend the previous analysis to predict the spatial variability of yield for the last 16 years yield and improve on the ability of the model to extrapolate the yields far beyond the trial sites. Recent research pointed that machine learning models fitted using random cross-validation shows high agreement of predictions at the location of trial sites but may overfit if extrapolated to areas beyond the training samples (Meyer *et al.*, 2019[[17]](#footnote-17) and Ploton *et al.*, 2020[[18]](#footnote-18)). They argued that the random cross-validation leads to considerable overfitting and results in models that can reproduce the training data but fail to make spatial predictions. This is partly because they do not account for spatial autocorrelation of trial sites thus leading to over-optimistic predictions at sample sites. Meyer *et al* 2019 (see the previous footnote) showed that for the spatio-temporal data, spatial dependencies can cause a misinterpretation of certain predictor variables which makes flexible algorithms fail when predicting beyond the location of the training data. For the proposed work, a spatial cross-validation procedure will be incorporated when training the machine learning models to investigate if it can improve the current model’s ability to predict yields beyond the locations of the trial’s sites. Moreover, spatial feature selections will be employed to eliminate variables that do not lead to better spatial predictions of maize yields beyond the trial sites. The newly added on-farm trial data for the 2017 to 2020 seasons will be incorporated to improve the training of the maize yield model. The robustness of the spatial predictions of maize yields will be evaluated using three machine learning algorithms i.e. the random forest (RF), eXtreme Gradient Boosting (XGboost), and spectral vector machines. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | |
| 2.1 Identify the extrapolation domains for conservation agricultural practices in the southern Africa region. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | |
| 3.1 What are biophysical and socio-economic factors that most limit maize yield in CA systems in the southern Africa region? | | | | | | | | | | | |
| 3.2 Which machine learning algorithm more accurately predicts the spatial variability of maize grain yields in CA systems in the southern Africa region? | | | | | | | | | | | |
| 3.2 Does spatial cross-validation improve the accuracy of predicting maize grain yield beyond the trial sites? | | | | | | | | | | | |
| 3.3 Where do different CA systems offer yield advantage over CP systems duration in seasons with below and above-average precipitation? | | | | | | | | | | | |
| 3.442 Is inter-seasonal variability of maize yield from CA systems lower compared to CP systems? | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc). | | | | | | | | | | | |
| Experiment design, implementation, and data analysis  This study will utilize data on maize grain yield and GAPs which are obtained from multi-year and multi-location on-farm trials spanning up to 16 years from the CIMMYT. The CIMMYT CA long-term trial network database contains information on maize grain yields and conservation agriculture (CA) and complementary technologies applied. Data for biophysical and socio-economic predictor variables will be obtained from remote sensing platforms. The spatial variability of maize yield from 7 CP and 13 CA systems will be estimated and compared. The spatial predictions of maize yields will be evaluated using three machine learning algorithms i.e. the random forest (RF), eXtreme Gradient Boosting (XGboost), and spectral vector machines. The model will be parameterized as follows:  Maize-yield [t ha-1] = f[Treatment + Variety + CA period + Soil + Climate + Terrain + Socioeconomic + EVI+ XY coordinates]  Where: Maize-yield is the maize yield (response), tillage treatments, variety are seeds of 18 different maize cultivars in the treatments (e.g. ‘ZM309’). The CA period is the time since the CA trial was first established in the trial plot. EVI is the enhanced vegetation index from MODIS satellite and is a proxy for vegetation productivity.  The single RF model aimed at predicting the spatial variations of the maize yields resulting due to the effect of the gridded biophysical and socioeconomic covariates as well as the categorical agronomic variables such as CA systems, maize varieties, and time since implementation of CA practices. The calibrated RF model was applied to generate numerous maps showing the predicted maize yield resulting from combinations of CA and complementary technologies.  The study area will be split into regular blocks with equal surfaces to ensure that the spatial cross-validation samples are drawn from different blocks when training the ML models. The models will be evaluated by R2 and RMSE obtained by comparing the observed and the predicted crop yields. The calibrated model will be used for spatial prediction of seasonal grain yields (2005 - 2020) from CA and CP systems combined with complementary technologies such as cultivars. The per-pixel yield advantage of CA practices will be calculated as the difference between the predicted yield from the CA and CP treatments. The coefficient of variation (CV) of grain yield for the 16 seasons will be used to assess inter-seasonal variability of yields for different CA and CP systems. This variability will be compared to the CV of precipitation to assess the resilience of CA and CP systems to climate variability. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 5. Data to be collected and uploaded | | | | | | | Responsibility/Institute | | | | |
| 5.1 CA long-term trial network database (already uploaded in dataverse) | | | | | | | Christian Thierfelder – CIMMYT | | | | |
| 5.2 Remote sensing data (open source) | | | | | | | Francis Muthoni – IITA | | | | |
|  | | | | | | | | | | | |
| 6. Milestones | | | | | | | | | | | |
| Deliverables | | | | | | | Means of verification | | | Date | |
| 6.1 Maps – Inter-annual maize yields from CA & CP systems | | | | | | | Report with maps | | | Sep. 2021 | |
| 6.2 Maps- Yield advantage of CA system in different seasons | | | | | | | Report with maps | | | Sep. 2021 | |
| 6.3 Multi-year yield variability and yield advantages | | | | | | | Journal article (verified by CS) and submitted | | | Sep. 2021 | |
|  | | | | | | | | | | | |
| 7. How will scaling be achieved? | | | | |  | | | | | | |
| The produced yield maps will guide scaling out of validated CA practices and improved maize cultivars to the most suitable niches. They will be disseminated to extension staff and development partners | | | | | | | | | | | |
|  | | | | |  | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | | | | | | |
| Sub-Activity 2.2.1.1: Component long term trials on maize/legume intercropping strategies with pigeon pea, lablab, and cowpea | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 9. Estimated budgets (US$) | | | | |  | | | | | | |
| Budget Line | | | | | IITA | | | | | | |
| Personnel (ML modeler 3 months @ $5,280) | | | | | 15,840 | | | | | | |
| Intern subsistence cost: 4 Months @$200) | | | | | 800 | | | | | | |
| Services | | | | | 0 | | | | | | |
| Services (3 Month subscription to virtual high processing machines @ $1,300) | | | | | 3,900 | | | | | | |
| Supplies (annual ArcGIS license) | | | | | 600 | | | | | | |
| Capital | | | | | 0 | | | | | | |
| Travel (conference registration/travel) | | | | | 5,000 | | | | | | |
| Sub-Grantee: | | | | | 0 | | | | | | |
| Overhead | | | | | 0 | | | | | | |
| Total | | | | | 26,140 | | | | | | |

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| 10. Gantt chart | | | | | | | | | | | | |
|  | 2020 | | | 2021 | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Literature review |  |  |  |  |  |  |  |  |  |  |  |  |
| Processing CA trial data [2017 - 2020] |  |  |  |  |  |  |  |  |  |  |  |  |
| Model calibration & Accuracy assessment |  |  |  |  |  |  |  |  |  |  |  |  |
| Write-up manuscript |  |  |  |  |  |  |  |  |  |  |  |  |
| Submit manuscript |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | | | |
| a. Output: 1.3 | Tools (including ICT-based) and approaches for disseminating recommendations in relation to above research products, integrated in capacity development | | | | | |
| b. Activity: 1.3.1 | Conduct extrapolation domain analysis based on GIS, agro-ecology, and crop model-generated information to establish the potential of technologies for geographical reach | | | | | |
| c. Sub-activity: 1.3.1.4 | Produce regionally relevant extrapolation domain maps for validated soil and water conservation practices Tanzania | | | | | |
|  |  | | | | | |
| d. Research team | | | | | | |
| Name | Institution | | Role | | | |
| Francis Muthoni | IITA | | PI | | | |
| Anthony Kimaro | ICRAF | | Provide technologies and their validation data | | | |
| Elirehema Swai | TARI-Hombolo | | Provide technologies and their validation data | | | |
| Shitindi Mawazo | SUA | | Provide technologies and their validation data | | | |
| Jonathan Reith/Olena Dubovyk | Bonn University | | Model land degradation risk | | | |
|  | | | | | | |
| e. Student(s): Nil | | | | | | |
|  |  | | | | | |
| f. Location(s) | Tanzania: Kongwa & Kiteto Districts | | | | | |
|  |  | | | | | |
| g. Start | Sep. 2018 | | | | | |
|  |  | | | | | |
| h. End | Sep. 2021 | | | | | |
|  |  | | | | | |
| 1. Justification | | | | | | |
| Sustainable intensification technologies are suited to specific biophysical and socio-economic contexts. Technologies validated at a location should be suitable for scaling to other locations with relatively similar biophysical and socio-economic contexts. Identification of areas with relatively similar conditions or outcomes to that observed in the technology trial sites is one essential component of successful scaling out. Biophysical conditions or yields obtained from trial sites with good performance of technological packages will be used as a reference for mapping other potentially suitable sites in the ESA region. During the 2019-2020 season, research was undertaken to map the hotspots of land degradation using remote sensing data in Kongwa and Kiteto districts of Tanzania. The trends of land productivity, land cover, and soil organic carbon were used as a proxy of land degradation. A field assessment of types and magnitude of land degradation together with the sustainable land management practices in Kongwa district. The study developed a method of monitoring land degradation at sub-national scales that used high spatial resolution remote sensing data that enabled the identification of subtle changes in land productivity in an area dominated by small-scale farms. Hotspots for land degradation in Kongwa and Kiteto districts of Tanzania were identified that could be prioritized for the targeting of soil and water conservation practices to reverse the land degradation trend. An MSc thesis on this work was submitted to the University of Bonn. The plan for the current season is to write a research paper for submission to a journal. | | | | | | |
|  | | | | | | |
| 2. Objectives | | | | | | |
| 2.1: Identify where in the ESA region the validated technological packages can be extrapolated with the lowest potential risk of failure. | | | | | | |
|  | | | | | | |
| 3. Research questions | | | | | | |
| 3.1 What is the spatial distribution of land degradation risk in Kongwa and Kiteto districts, Tanzania? | | | | | | |
| 3.2 What are priority sites for land rehabilitation in KK Districts based on the state, trajectory, and performance of land degradation indicators? | | | | | | |
|  | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc). | | | | | | |
| Experiment design, implementation, and data analysis  Gridded time series data on land cover, soil organic carbon, and land productivity (Normalized Difference Vegetation Index (NDVI) will be utilized to generate a map on land degradation index. The Land Degradation Neutrality Framework developed by United Nations Convention Combat Desertification (UNCCD) will be utilized to quantify the trajectory, state, and performance of each of the three state variables. The three indicators of degradation for all three state variables will be integrated to create a land degradation index with five classes: improving, stable, stable but stressed, early signs of decline and decline. | | | | | | |
|  | | | | | | |
| 5. Data to be collected and uploaded | | | | | Responsibility/Institute | |
| No data collection is planned, only write-up of manuscript | | | | |  | |
|  | | | | | | |
| 6. Milestones | | | | | | |
| Deliverables | | | | Means of verification | | Date |
| 6.1 Publication on land degradation neutrality | | | | 1 journal article (verified by CS) submitted | | Apr. 2021 |
|  | | | | | | |
| 7. How will scaling be achieved? | | | | | | |
| The land degradation index (LDI) map will guide the spatial targeting of soil and water conservation practices in the ESA region | | | | | | |
|  | |  | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | |
| Sub-activity 2.1.1.4 Land rehabilitation through the integration of fodder trees and grass forage species in dryland farming  Sub-activity 1.1.1.5 Determining the productivity and resilience benefits of Gliricidia-based cropping systems  Sub-activity 2.2.1.5 Evaluation of land rehabilitation benefits of shelterbelts and contours  Sub-activity 2.2.1.7 Demonstrate technologies on soil and water conservation for enhancing resilient to climate change in semi-arid agro-ecologies of Central Tanzania | | | | | | |
|  | |  | | | | |
| 9. Estimated budget (US$) | |  | | | | |
| Budget Line | | IITA | | | | |
| Personnel (Student research costs) | |  | | | | |
| Services: Open source publication fee | | 2,000 | | | | |
| Supplies | |  | | | | |
| Capital | | 0 | | | | |
| Travel | | 0 | | | | |
| Sub-Grantee: | | 0 | | | | |
| Overhead (15%) | | 0 | | | | |
| Total | | 2,000 | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10. Gantt chart | | | | | | | | | | | | | |
|  | 2020 | | | 2021 | | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Field assessment of Land degradation Kiteto |  |  |  |  |  |  |  |  |  |  |  |  |
| Fine-tune spatial predictions |  |  |  |  |  |  |  |  |  |  |  |  |
| Write-up manuscript |  |  |  |  |  |  |  |  |  |  |  |  |
| Submit manuscript |  |  |  |  |  |  |  |  |  |  |  |  |

## Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a. Output 2.1 | | Demand-driven research products for enhancing soil, land, and water resources management to reduce household/community vulnerability and land degradation piloted in priority agro-ecologies | | | | | | |
| b. Activity 2.1.1 | | Characterize current practices in ESA through identifying formal and informal arrangements for access to and use of water and land resources | | | | | | |
| c. Sub-activity 2.1.1.1 | | Assessing buffer and adaptive capacity to harness resilience of different farm types | | | | | | |
|  | | | | | | | | |
| d. Research team | | | | | | | | |
| Name | | | | Institution | | | Role | |
| Jeroen Groot | | | | WUR | | | Activity coordinator | |
|  | | | | | | | | |
| e. Student(s): Nil | | | | | | | | |
|  | | | | | | | | |
| f. Location | Babati, Tanzania | | | | | | | |
|  | | | | | | | | |
| g. Start | 1 Oct. 2019 | | | | | | | |
|  | | | | | | | | |
| h. End | 1 Oct. 2021 | | | | | | | |
| 1. Justification | | | | | | | | |
| Vulnerability and resilience are two crucial attributes of smallholder farming systems that can be used for analyzing the response to disturbances. We will assess these properties in relation to the buffer and adaptive capacity, which depend on the ‘window of opportunities’ of possible changes in terms of productive, socio-economic, and environmental performance indicators, i.e., the ‘solution space’. The vulnerability of the system can be quantified as the distance of selected performance indicators between original and disturbed systems. The buffer capacity will be derived from the size of the solution space that could be obtained after reconfiguration of farm components (crops, animals, fertilizers, etc.) that were present on the original farm, whereas the assessment of adaptive capacity was derived similarly but after allowing innovation by introducing new components to the farm. These features will be different for the various farm types in Babati (Tanzania) since they depend on the context (biophysical and socio-economic) and the resources and activities of farms and households. Below we describe the conceptual basis. The activity builds on existing datasets of farm and household structure and farming (from surveys such as ARBES) practices and the proposed and tested Africa RISING technologies (from project scientists).  Conceptual basis:  A disturbance can be a pest, a drought, or a product price decline that negatively affects the farming system's performance. The farmer can prepare for or respond to a disturbance by reconfiguring the farm with changes in for instance crop areas, animal numbers, amounts of inputs, selected market channels, or management practices to compensate for the effect of the disturbance. The available options for adjustment of the system with existing components and resources can be considered the ‘buffer capacity’. When the farmer decides to introduce new crops, animals, inputs, or practices, the required adjustment and reconfiguration (both in the ecological system and in farm management) is expected to be considerably larger than for the buffer capacity and is reflected in the ‘adaptive capacity’. This illustration of the concepts for an agroecosystem demonstrates that besides the ecological (self-)organization, the farmer, his flexibility and skills, and his cognitive and managerial capacities will determine the chosen strategy of adaptation and the final effectiveness of reconfiguration, and thus agroecosystem resilience.  All possible combinations of values of performance indicators constitute the ‘window of opportunities’ or ‘solution space’ for a particular system. The potential of a system (P), resulting from the buffer and adaptive capacity, can be derived from the size of the solution space, which defines the options for adjustment of the system. The solution space is delimited by the Pareto frontier (or Pareto surface when more than two performance criteria are included in the analysis), and for assessment of resilience, we consider only options that perform at least as good as the existing system. The Pareto frontier can be established using multi-objective optimization, and the area (in 2 dimensions), volume (3 dimensions), or hypervolume (>3 dimensions) of the solution space can be calculated, for instance, relative to a given reference point that represents the existing situation.  This is demonstrated in Figure 1, wherein only the portion of the solution space with improvements in two system indicators (productivity and environmental quality in this case) relative to the existing situation after a disturbance is depicted. The buffer capacity (area B in Figure 1a) is estimated as the solution area corresponding to the reconfiguration of links and flows among the components that are already in the system. The adaptive capacity (area A in Figure 1a) is estimated as the expansion of the solution area when new components are introduced in the system. The potential (P) is estimated as the sum of areas A and B.  Macintosh HD:Users:jeroengroot:Dropbox:Artikelen:027 Resilience:Submitted ES:Figure 1.gif  Figure 1. Portions of solution spaces with future options that perform better for two generic objectives, productivity and environmental quality, relative to disturbed states denoted by red symbols. (a) After a disturbance, the system states change following the arrow from point 1 to point 2 (vulnerability v is the distance between points 1 and 2) and move to a more desirable state such as point 3 (resilience r is the distance between points 2 and 3). Area A represents the adaptive capacity and B the buffer capacity of the system after the disturbance. Potential P is calculated are the sum of areas A and B. White symbols denote alternatives for the current system. (b) The potential of a system at consecutive moments in time, with changing attained states (points 1, 3, 5, and 7) and after disturbances (points 2, 4, and 6). | | | | | | | | |
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| 2. Objectives | | | | | | | | |
| * 2.1 Analyze input-output relations for farm production activities (cropping, animal husbandry, etc.) * 2.2 Quantify potential effects of disturbances on-farm production activities for multiple performance indicators. * 2.3 Model farm/household level effects of disturbances to assess vulnerability for different farm types * 2.4 Quantify the buffer and adaptive capacity of farms and households of different types * 2.5 Establish pathways to harness farm and household resilience for different farm types | | | | | | | | |
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| 3. Research questions | | | | | | | | |
| 3.1 To what extent are productive, socio-economic, and environmental performance indicators at the farm and household level affected by biophysical and socio-economic disturbances (e.g., drought, price fluctuation | | | | | | | | |
| 3.2 What are the buffer and adaptive capacity of different farm and household types for disturbances in terms of selected productive, socio-economic, and environmental performance indicators? | | | | | | | | |
| 3.3 Which efficient pathways for performance improvement can be used to recover after disturbances by different types of farms or households? | | | | | | | | |
|  | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | |
| Experiment design, implementation, and data analysis   * FarmDESIGN modeling using existing parameterized farms/ households for three farm types per region * Inventory of production activities that are used on farms or tested by the project (technologies), these production activities (inputs and outputs) are added to the farm models as input data but can also be used to validate the models * Individual discussions and focus group discussions with farmers and experts to assess the feasibility of changes pathways to harness resilience * Surveys, focus group discussions, farming systems modeling, and a serious game. | | | | | | | | |
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| 5. Data (with metrics) to be collected and uploaded on Dataverse | | | | | | | | |
| Domain | | | Indicator | | | Metrics and scale | | |
| Non-domain | | | Parameterized model for various farm types per region | | |  | | |
| Productivity | | | Crop productivity | | | Crops yield (kg/ha/year) under regular and disturbed conditions (at field and farm levels) | | |
|  | | | Animal productivity | | | Animal products (kg/animal/year) under regular and disturbed conditions (at animal and farm levels) | | |
|  | | | Input use efficiency | | | Product per input (at field, herd, and farm levels) | | |
| Economic | | | Profitability | | | Gross margin of crop and animal operations and operating profit of farm operation (USD) | | |
|  | | | Labor requirement | | | Labor requirements at field, animal, herd, farm, and household levels | | |
| Environmental | | | Soil chemical quality | | | Carbon and nutrient (N, P, K) budgets, losses to air and soil (at field and farm levels) | | |
| Human condition | | | Nutrition | | | Nutrient production (kg/year) at field and farm levels; Dietary Diversity (using Nutritional functional Diversity/Dispersion) | | |
|  | | | Food security | | | Food production (kcal/year) at field and farm levels. Food accessibility | | |
|  | | | Capacity to experiment | | | Willingness to implement a new farm configuration after disturbance | | |
| Social | | | Equity | | | Rating of farm configurations per group and agency (leadership roles) | | |
|  | | | | | | | | |
| 6. Deliverables | | | | | Means of verification | | | Delivery date |
| 6.1 Journal article submitted | | | | | PDF of submitted papers to Chief Scientist | | | 31 Jan. 2021 |
| 6.2 MSc thesis/ student report | | | | | PDF of reports | | | 10 Jan. 2021 |
| 6.3 Research data generated | | | | | Data uploaded in Dataverse | | | 31 Mar. 2021 |
| Note: these deliverables were also in the 2019-20 workplan. Due to delays, these will be submitted early 2021. | | | | | | | | |
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| 7. How will scaling be achieved? | | | | | | | | |
| Our assessment builds upon a locally validated but general pattern of inter- and intra-household diversity. Since our case study households have been selected as representative for farm types of different resource endowments, we expect our findings to be relevant to most other farms of the same type. (We envision testing the transferability of our results by Focus Group Discussions and individual consultations beyond the current case study site to ensure greater validity). Our findings mean to guide Africa Rising’s scaling effort, in that we reveal how the resilience of the different farm and farmer types can be improved best by which of the Africa RISING technologies. | | | | | | | | |
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| 8. How are the activities in this protocol linked to those of others? | | | | | | | | |
| The modeling exercise builds on past and ongoing Africa RISING trial data i.e. data from the on-farm experiments as well as the farmer-led baby- and upscaled trials. The models will be updated, extended, and tested in close collaboration with the Africa RISING-regional coordinators and other project experts in Arusha. | | | | | | | | |
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| 9. Budget: Activities will be covered by funds carried forward from the 2019-2020 workplan | | | | | | | | |
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| 10. Gantt Chart | 2020 | | | 2021 | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep |
| Analysis |  |  |  |  |  |  |  |  |  |  |  |  |
| Write report |  |  |  |  |  |  |  |  |  |  |  |  |
| Write article |  |  |  |  |  |  |  |  |  |  |  |  |
| Revise article after review |  |  |  |  |  |  |  |  |  |  |  |  |
| Submit data |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies | | | | |
| a. Output 2.2 | Innovative options for soil, land and water management in selected farming systems demonstrated at strategically located learning sites | | | |
| b. Activity 2.2.1 | Set up demonstration and learning sites in target ESA communities | | | |
| c. Sub-activity 2.2.1.2 | Investigations on nutrient and water management for climate resilience along a climate gradient in southern Malawi | | | |
|  | | | | |
| d. Research team | | | | |
| Name | Institution | Role | | |
| Chikowo R, Snapp S | MSU | PIs, lead overall work | | |
| Julius Manda | IITA | Conduct economic analysis on profitability of different options | | |
|  | | | | |
| e. Student(s): Nil | | | | |
|  | | | | |
| f. Location(s) | Mtubwi, Nsanama, Nyambi, Extension Planning Areas (EPAs) | | | |
|  |  | | | |
| g. Start date | October 2016 | | | |
|  |  | | | |
| h. End date | August 2021 | | | |
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| 1. Justification | | | | |
| Experiments on nutrient and water management have been carried out over the past three seasons and generated a lot of interest among farmers in southern Malawi. Only a few critical sites will be maintained in Ntubwi, Nsanama, and Nyambi extension planning areas. This is meant to further consolidate action learning with farming communities during the closeout year. Southern Malawi ranks as one of the areas with very high seasonal rainfall variability. Therefore, farmers are exposed to climatic risk in environments with high inter- and intra-season rainfall variability, making fertilizer investments unattractive. Simple approaches to buffer farmers against soil moisture stresses are required. These include in-situ storage of rainwater that comes as high-intensity storms associated with large run-off. Simple physical structures such as tied ridges increase residence time for rainwater to infiltrate. This work will facilitate the institutionalization of approaches that enhance resilience within the Malawi extension services, as the few trials that will be established will be largely led by extension as a platform for their field days.  Achievement against output: During drought years, our research has shown significant productivity gains in crops and better fertilizer use efficiencies. We have seen consistent gains of at least 300 kg/ha when water management is superimposed on nutrient management. We estimate that 10% of the farmers are already integrating tied ridges on portions of their farms, especially in drought-prone areas of the Machinga district. This work underpins the building of resilience under variable rainfall conditions. During this final year, we will seek to better understand the impediments to the implementation of tied ridges at the farm scale. The question is – if results from experiments are almost always positive, and farmers report little extra labor requirement with tied ridges, why then is this technology not widely adopted by the majority of farmers, especially in the drought-prone regions. | | | | |
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| 1. Objectives | | | | |
| 1.1 Use a few field experiments as a platform for technology dissemination and community discourses for finding solutions to crop failure related to soil water deficits.  1.2 To further investigate the interactions between rainfall received (season type), nutrient management, and soil type, at one on-farm experiment for each of three agro-ecologies (sites) in Machinga district. | | | | |
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| 3. Research questions | | | | |
| 3.1 What are the impediments to the wide-scale adoption of tied-ridges as a water conservation measure in the drought-prone Machinga district? | | | | |
| 3.2 Does in-situ water harvesting through tied ridges result in better nutrient and water use efficiencies across sites and rainfall seasons? | | | | |
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| 4. Experiment design, implementation, and data analysis | | | | |
| To investigate the interactions between rainfall received, nutrient management, and soil type, we will maintain one site for experiments that were set up in Machinga during the 2018 cropping season. The main plot factor will be water management (tied or no-tied ridges) while sub-plots factors are NP management and cropping sequencing: 1) continuous non-fertilized maize, 2) maize fertilized at 35 or 70 kg N ha-1 [N-35 or N-70], 3) sole groundnut or a groundnut/pigeon pea intercrop, both sequenced with maize in Years 2 and 3.   1. Maize– control 2. Maize – control with tied ridges (with TR) 3. Maize + fertilizer (full rate NP) (continuous maize every year) 4. Maize + fertilizer (full rate NP) with TR (continuous maize every year) 5. Maize + fertilizer (half rate NP) following groundnut +TR 6. Maize + fertilizer (half rate NP) following groundnut +TR 7. Maize following groundnut + pigeon pea 8. Maize following groundnut + pigeon pea with TR 9. Maize + fertilizer (half rate NP) 10. Maize + fertilizer (half rate NP) with TR   Tied ridges management:   * Tied ridges will be made at planting time to capture as much rainwater as possible * Flexible ridge management – ridge ties must be broken during flooding periods (when there are continuous rains for over 7 days) | | | | |
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| 5. Data (with metrics) to be collected and uploaded on DataVerse   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method | Responsible | | Productivity | | | | | | MSU | | Maize grain productivity | Maize grain and biomass yield (kg/ha/season); | Maize production (kg/ha/season) |  |  | Yield measurements | MSU | | Legume productivity | Soybean/groundnut grain and biomass yield (kg/ha/season); |  |  |  | Yield measurements | MSU | | Yield gap | Yield gap for maize, soybean, groundnuts (kg/ha/season) |  |  |  | Yield measurements | MSU | | Economic | | | | | |  | | Profitability | Net income ($/crop/ha/season);  Gross margin |  |  |  | Survey |  | | Labor requirement |  |  | Farmer rating of labor |  | Farmer evaluation |  | | Environmental | | | | | |  | | Water availability | % of plants wilting |  |  |  | Survey; participatory exercise | MSU | | Erosion | Rating of soil erosion |  |  |  | Participatory exercise | MSU | | Human condition | |  |  |  |  | MSU | | Nutrition | Protein production (g/ha) |  |  |  | Lookup tables | MSU | | Food security | Food production  (calories/ha/year) |  | Months of food insecurity |  | Survey | MSU | | Social | | | | | |  | | Gender equity | Rating of technologies by gender |  |  |  | Participatory evaluation | MSU | | Social cohesion |  |  |  | Participation in social groups | Key informant interviews |  | | | | | |
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| 6. Deliverables | | | Means of verification | Delivery date |
| 6.1 Field protocols updated and available | | | Field protocols | Jan. 2021 |
| 6.2 One nutrient x water management trial established per EPA | | | Field trials established | Jan. 2021 |
| 6.3 One field day held with partners in Machinga | | | Field day report | Apr. 2021 |
| 6.4 Soil water and nutrients use interactions assessed | | | Draft publication, verified by Chief Scientist | May/Jun. 2021 |
| 6.5 At least 15,000 smallholder farmers practicing water conservation practices | | | Extension reports, DAECC reports | Sep. 2021 |
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| 7. How will scaling be achieved? | | | | |
| Malawi extension system is mainstreaming activities in different districts. Any NGOs in districts will be invited to fields days and get exposed to the technology for possible scaling. | | | | |
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| 8. How are the activities in this protocol linked to those of others? | | | | |
| CIAT is mainstreaming water management in common bean intensification; water management technologies are also being implemented in Africa RISING Tanzania.  CIMMYT uses CA as a strategy for increasing soil water availability to improve crop productivity (Sub-activity 5.1.1.1). This objective is core to this sub-activity. | | | | |
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| 9. Gantt chart | | | | | | | | | | |
|  | 2020 | | 2021 | | | | | | | |
| Activity/ month | Nov | Dec | Jan | Feb-Mar | Apr | May | Jun | Jul | Aug | Sep |
| Procurement of inputs |  |  |  |  |  |  |  |  |  |  |
| IITA-MSU contract/inputs distribution |  |  |  |  |  |  |  |  |  |  |
| MSU/partners contracting |  |  |  |  |  |  |  |  |  |  |
| Establishment of trials |  |  |  |  |  |  |  |  |  |  |
| Field assessments/data collection |  |  |  |  |  |  |  |  |  |  |
| Post-harvest workshops/feedback meetings |  |  |  |  |  |  |  |  |  |  |
| Report writing/publications |  |  |  |  |  |  |  |  |  |  |
| DataVerse data upload |  |  |  |  |  |  |  |  |  |  |

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| Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies | | | | | | | | | |
| a. Output 2.2 | | | Innovative options for soil, land and water management in selected farming systems demonstrated at strategically located learning sites | | | | | | |
| b. Activity 2.2.1 | | | Set up demonstration and learning sites in target ESA communities | | | | | | |
| c. Sub-activity 2.2.1.3 | | | Test climate-smart farming practices (tied ridges, weather-informed varieties, cover crops integration [cowpea, medium duration pigeon pea]) for increasing productivity of maize-legume system under variable weather conditions | | | | | | |
|  | | | | | | | | | |
| d. Research team | | | | | | | | | |
| Name | | Institution | | Role | | | | | |
| Job Kihara | | CIAT | | PI | | | | | |
| Jonas Julius and Rose Anael | | MoA | | Arrange and supervise field operations by farmers | | | | | |
| Daniel Mgalla | | IITA | | Provide support in monitoring of the research activities to ensure compliance with the FtF monitoring system including periodically assisting in data collection (both FtF and Custom indicators data) with critical gender perspective and uploading into the FtF system | | | | | |
|  | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | |
|  | | | | | | | | | |
| f. Location(s) | | Sabilo and Gallapo in Babati District, Tanzania | | | | | | | |
|  | | | | | | | | | |
| g. Start date | | December 2016 | | | | | | | |
|  | | | | | | | | | |
| h. End date | | November 2021 | | | | | | | |
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| 1. Justification | | | | | | | | | |
| This is a continuing activity. It is based on the need to provide options that help farmers manage challenges related to weather variability in crop production. This need was also expressed by farmers during a stakeholder needs assessment before Phase-2 of Africa RISING (progress reports by Kihara). In Babati, the 2015-16 cropping season, there were large losses in productivity due to in-season drought. Opportunities being tested include utilizing weather forecasts information in making decisions on planting dates, integration of in situ water harvesting, cover crops, and improved fertilizer management. This research addresses the response of crops to the combined application of these technologies and includes participatory evaluation, with a gender perspective, by farmers. The last 2 seasons of this activity have not provided sufficient data for a proper understanding of the benefits of these climate-smart agriculture practices. We will continue the activity at a reduced scale, i.e., one field in Gallapo and one field in Sabilo, under control by extension agents/researchers. | | | | | | | | | |
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| 2. Objectives | | | | | | | | | |
| 2.1 To assess the effects of different climate-smart farming practices on the productivity of maize and pigeon pea | | | | | | | | | |
|  | | | | | | | | | |
| 3. Research questions | | | | | | | | | |
| 3.1 To what extent do tied ridges affect productivity in different ecozones and weather variability in Northern Tanzania? | | | | | | | | | |
| 3.2 To what extent is crop diversification an option for improving resilience under climate variability? | | | | | | | | | |
| 3.3 What are the gross margins associated with selected climate-smart agricultural practices in northern Tanzania? | | | | | | | | | |
|  | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | |
| Experiment design, implementation, and data analysis:  The experiment is laid out as a randomized complete block design with 7 treatments (described in the research protocol). In each field, each treatment is replicated 3 times. Treatment plot sizes are 7m x 5m. The net plot used for measurements of grain and biomass will leave out 1 m from each side of the plot to reduce border effects. In all treatments, two maize seeds will be planted at a spacing of 25cm × 75cm, and later thinned to one, to attain a plant population of 53,333 plants per hectare. Pigeon pea and beans are planted to also attain similar densities across plots. The detailed protocols as used in the previous season are attached here. | | | | | | | | | |
|  | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | |
| Domain & Indicator | Field/plot level metrics | | | Farm level metrics | Household level metrics | Community/landscape level metrics | | Measurement method | |
| Productivity | | | | | | | | | |
| Crop productivity | Maize, beans, pigeon pea, and cowpea productivity (kg/ha/  season) | | |  |  |  | | Yield measurements | |
| Variability of production |  | | |  | Rating of production risk |  | | Farmer evaluation | |
| Biomass productivity | Maize, beans, pigeon pea, and cowpea biomass productivity (kg/ha/  season) | | |  |  |  | | Yield measurements | |
| Residue production (kg/ha/  season) | | |  |  |  | | Yield measurements | |
| Rating of residue production | | |  |  |  | | Farmer evaluation | |
| Economic | | | | | | | | | |
| Profitability | Gross margins ($/crop/ha/ season) | | |  |  |  | | Participatory evaluation | |
| Labor requirement | Labor requirement (hours/ha) | | |  | Farmer rating of labor |  | | Farmer evaluation | |
| Variability of profitability |  | | |  | Probability of low profitability |  | | Farmer evaluation | |
| Environmental | | | | | | | | | |
| Fuel availability, soil | Fuel biomass (kg/ha/season) | | |  |  |  | | Participatory exercise | |
| Human condition | | | | | | | | | |
| Nutrition | Protein production (g/ha) | | |  |  |  | | Lookup tables | |
| Food security | Food production (calories/ha/year) | | |  | Months of food insecurity; Rating of food security |  | | Field measurement/ lookup tables/ Participatory  Assessment | |
| Social | | | | | | | | | |
| Gender equity |  | | |  |  | Rating of technologies by gender | | Participatory evaluation | |
|  | | | | | | | | | |
| 6. Deliverables | | | | | | | Means of verification | | Delivery date |
| 6.1 Two on-farm trials, 1 in each of 2 eco-zones, successfully Implemented | | | | | | | Research reports | | Oct. 2021 |
| 6.2 Thirty farmers trained | | | | | | | Training report | | Aug. 2021 |
| 6.3 Summary effects of climate-smart practices | | | | | | | Research reports | | Nov. 2021 |
|  | | | | | | | | | |
| 7. How will scaling be achieved? | | | | | | | | | |
| We developed a field guide that shows different best agronomic practices including aspects of climate-smart technologies. We will also demonstrate to extension staff the performance of the technologies in the field. We are currently partnering with Meru Agro Seed Company to deliver improved maize seeds and provide advice to farmers. We will utilize the Mwanga ICT platform for communicating agronomic information. Besides, farmers already enlisted in Mwanga will receive agronomic messages. | | | | | | | | | |
|  | | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | | | | |
| Field level data from this activity will feed into farm-level farming systems work led by Lieven Claessens. Data from micro-catchments will complement assessments being undertaken in Kongwa-and Kiteto sites. We are utilizing Mwanga ICT, a tool developed within Africa RISING. | | | | | | | | | |

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| 9. Gantt chart | | | | | | | | | | | |
|  | 2020 | 2021 | | | | | | | | | | | |
| Activity/ month | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | |
| Input acquisition, field marking, planting trials |  |  |  |  |  |  |  |  |  |  |  | |
| Co-development of Mwanga messages and messaging |  |  |  |  |  |  |  |  |  |  |  | |
| Topdressing |  |  |  |  |  |  |  |  |  |  |  | |
| Field days, rating of technologies and bean harvesting, 2nd top dressing |  |  |  |  |  |  |  |  |  |  |  | |
| Maize harvesting, drying, weighing and sample pre-processing |  |  |  |  |  |  |  |  |  |  |  | |
| Weeds and pest disease control |  |  |  |  |  |  |  |  |  |  |  | |
| Pigeon pea harvesting |  |  |  |  |  |  |  |  |  |  |  | |
| Seasonal data analysis, Dataverse publishing, and end of year reporting |  |  |  |  |  |  |  |  |  |  |  | |

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| Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies | | | |
| a. Output 2.2 | Innovative options for soil, land and water management in selected farming systems demonstrated at strategically located learning sites [and scaled in Outcome 5] | | |
| b. Activity 2.2.1 | Set up demonstration and learning sites in target ESA communities | | |
| c. Sub-activity 2.2.1.6 | Validation of residual tied ridging as a labor-saving technology in semi-arid areas of central Tanzania | | |
|  | | | |
| d. Research team | | | |
| Name | Institution | Role | |
| Elirehema Swai | TARI Hombolo | PI – Overall coordination and production of manuscript on crop and soil water variables | |
| Lutengano Edward Mwinuka | University of Dodoma | Data analysis and preparation of the economic section of the manuscript | |
| Emanuel Mbazi Msemo | SUA | Providing expertise on long term data analysis | |
| Julius Manda | IITA | Providing technical backstopping on the economic section of the manuscript | |
| Gundula Fischer | IITA | Preparation of the gender section of the manuscript | |
|  | | | |
| e. Student(s): Nil | | | |
|  | | | |
| f. Location(s): | Laikala, Mlali, Ngumbi and Sagara villages in Kongwa District | | |
|  | | | |
| g. Start date | 2016/2017 | | |
|  | | | |
| h. End date | September 2021 | | |
|  | | | |
| 1. Justification | | | |
| The introduction and popularization of technologies aiming at reducing drudgery for rural overburdened resource-constrained farming communities are immensely important. Over the last two cropping seasons, i.e., 2018/2019 and 2019/2020, information on sustainable intensification (SI) domains have been collected with a clear focus on labor requirements under in-situ rainwater harvesting (IRWH) technologies, notably annual and residual tied ridging. Similarly, information on economics and productivity has been collected. However, it has been noted that there is still a knowledge gap related to the efficacy of IRWH, notably knowledge on the efficacy of tied ridges (annually made ridges (ATR) and residual tied ridges (RTR)) in addressing the challenge of recurrent drought associated with the impact of climate change and variability is limited.  Therefore, during the 2020/2021 cropping season, a study that was initiated at Mlali during the 2019/2020 cropping season will continue for a second season to capture detailed information not collected in season one. In this study, drought conditions will be imposed at the flowering stage using the exclusion rainout shelter technique to mimic intra-seasonal droughts which normally occur in the central region of Tanzania, like the one during the 2018/2019 cropping season. At the same time, data will be collected from the ambient condition treatments to generate data that will further be used for quantifying the efficacy of the technology.  Furthermore, long-term data collected during 2016/2017 to 2019/2020 cropping seasons under sorghum and maize systems in the semi-arid areas of Kongwa District will be analyzed and a manuscript will be prepared. | | | |
|  | | | |
| 2. Objectives | | | |
| 2.1 To compare the effects of residual tied ridges, annually made tied ridges, and conventional farmer practice in addressing the challenge of drought during the cropping season. | | | |
|  | | | |
| 3. Research question | | | |
| 3.1 Which IRWH technology is effective in addressing the challenge of drought in the semi-arid areas of central Tanzania? | | | |
|  | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | |
| Experiment design, implementation, and data analysis  4.1. Use of rainout shelters to induce water stress for assessing the efficacy of *in situ* rainwater harvesting methods on soil water status and crop performance in semi-arid areas of Central Tanzania.  The induced drought stress experiment which was initiated at Mlali village, Kongwa District during the 2019/2020 cropping season will continue during the 2020/2021 cropping season. The rainout shelter will be installed in all treatments at the same time at the flowering stage. Rainout shelters will cover an area of 3m x 3m, will have a height of 2.4 m to 3.4 m, and a roof inclination of 18° for precipitation runoff (see research protocol, figure 2e). The rainout shelter will exclude all the ambient rainfall (i.e. 100%), to establish how long a crop can survive under the different treatments.  The field trial is arranged in a split-plot design with three replications. The treatments consist of three tillage methods notably conventional tillage and two IRWH notably annual tied ridges (ATR) and residual tied ridge (RTR) and two improved maize varieties namely commercial maize variety (i.e., DKC9089) and drought-tolerant maize (i.e., WE2109) thus giving a total of six treatment combinations.  Data to be collected  During 2020/2021 cropping season data will be collected both from ambient and rainout shelter conditions mainly on three sustainable intensification (SI) domains as follows:  (i) Soil moisture measurements will be measured by inserting a Delta-T Soil Moisture Sensors at depth of 10 cm, 20cm, 30cm, 50cm 70cm, and 90cm at the tasseling stage after imposing the rainout shelter in all plots with (rainout shelter) and without shelter i.e. under ambient rainfall condition. The soil moisture tensions measurements will be obtained from T4e tension meters which will be installed at a depth of 90cm in three tillage treatments at the flowering stage. Reading will be done at an interval of 3 days.  (ii) At physiological maturity maize grain will be harvested and immediately after threshing maize grain moisture will be measured using a moisture meter, finally maize grain yield from all treatments will be adjusted to 12.5% moisture content. Three maize plants will be collected in each treatment after cutting the whole maize plants at ground level for dry matter and stover yields measurements. The collected samples will be oven-dried at 70oC for 48 hours and finally, dry matter and stover yields will be measured accordingly. Other data which will be collected include the number of kernels per cob, 1,000 kernel weight.  (iii) Food security parameter will be estimated by converting maize grain yield per hectare in all treatment to calories produced per hectare using published constant conversion factors of dry grain weight to calories (i.e. 362 kcal 100g -1) as well as protein (i.e. 8.1g 100g -1) specific to Tanzania maize (Lukmanji *et al*., 2008[[19]](#footnote-19)).  Data analysis  Analysis of variance for biophysical variables namely crop growth/yield, soil hydrological variables will be run using Genstat software for data Use of rainout shelters to induce water stress for assessing the efficacy of in situ rainwater harvesting methods on soil water status and crop performance in semi-arid areas of central Tanzania.  4.2 Preparation of manuscript on validation of residual tied ridging as a labor-saving technology  Long-term data collected during the 2016/2017 cropping season to the 2019/2021 cropping season will be subjected to analysis. Finally, a manuscript will be prepared. To achieve this, a statistician, as well as a subject matter specialist, will be consulted for input.  Data analysis   * Biophysical variables: Analysis of variance for biophysical variables collected during 2016/2017 to 2019/2020 cropping seasons namely crop growth/yield, hydrological and physical variables will be run using Genstat software. * Food security: Food security parameters will be estimated by converting maize grain yield per hectare in all treatment to calories produced per hectare using published constant conversion factors of dry grain weight to calories as well as protein specific to Tanzania (Lukmanji *et al*., 2008[[20]](#footnote-20)). * Gender analysis: The MSc students from Dodoma University were involved in collecting the information on gender under the supervision of a gender expert from IITA. Thus, the IITA gender expert will liaise with students for their input on key findings noted during their study ready for incorporation into a manuscript. * To quantify the profitability of using rip tillage technology the Gross margin ($/ha) tool will be used. * Economic analysis: To quantify the profitability of using in situ rainwater harvesting technologies the Gross margin ($/ha) method will be used. | | | |
|  | | | |
| 5. Data to be collected and uploaded on DataVerse for 4.1 | | | |
| |  |  |  | | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Measurement method (details in research protocol) | | Productivity | | | | Crop (maize) productivity | Maize grain yield (kg/ha/season) | Yield measurements | | Crop biomass productivity | Stover production (kg/ha/season | Yield measurements | | Environmental | | | | Water availability | Soil moisture content (%) | Field tests | | Economics | | | | Profitability | Gross margin ($/ha) | Participatory evaluation | | Human condition | | | | Food security | Food production (calories/ha/year; Protein g/ha/year) | Lookup tables | | | | |
|  | | | |
| 6. Deliverables | | Means of verification | Delivery date |
| 6.1 Validation of residual tied ridging as a labor-saving technology | | Draft manuscript shared with co-authors and Chief Scientist | Mar. 2021 |
| 6.2 Validation of residual tied ridging as a labor-saving technology with incorporation of comments received from internal reviewers | | Confirmation of submission of manuscript from journal | May 2021 |
| 6.3 Edit peer-reviewed manuscript for publication on validation of residual tied ridging as a labor-saving technology | | Final submission to journal | Aug. 2021 |
| 6.4 One trial on rainout shelter study established at Mlali village, Kongwa District | | Mid-term report submitted to Project Manager | Mar. 2021 |
| 6.5 Farmers’ field day under rainout shelter trial at Mlali, Nghumbi, Laikala, and Sagara villages in Kongwa District | | Farmers Field Day report submitted to project communication officer | Jun. 2021 |
| 6.6 Data analysis and preparation of midterm and annual reports on rainout shelter | | Technical reports submitted to Project Manager | Mar. and Sep. 2021 |
| 6.7 Draft manuscript on rainout shelter trial | | Draft manuscript shared with co-authors and chief scientist | Sep. 2021 |

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| 7. How will scaling be achieved? |
| The DAICO for Kongwa will be consulted during the 2020/2021 cropping season to put in place modalities for engaging extension officers in Africa RISING action sites, i.e., Mlali, Nghumbi, Laikala, and Sagara villages. Similarly, farmers’ field days (FFDs) are an important platform to showcase best practices. The FFDs will engage farming communities in the project area as well as neighboring villages for improving decision-making about in-situ rainwater harvesting technologies. |
|  |
| 8. How are the activities in this protocol linked to those of others? |
| The in-situ rainwater harvesting technology is being validated with activity 1.2.2.2: Gender analysis of soil and water conservation technologies and 5.1.3-IITA on identifying and communicating gender-sensitive decision support technology in the context of different farm typologies. It is linked to sub-activity 1.1.1.7- SUA/IITA on monitoring the impact of weather and climate variability. Assess the effect of tied ridging, residual tied, and rip tillage on maize productivity, net crop returns, household income, and food security. |
|  |
| 9. How are the activities in this protocol linked to those of others? | |
| The in-situ rainwater harvesting technology is being validated with activity 5.1.3.3 SUA on assessing the integrative effect of in-situ rainwater harvesting and fertilizer micro-dosing on crop yield, water and nutrient use efficiency in technology Kongwa District. It is linked to sub-activity 4.1.1.4 Assess the effect of tied ridging, residual tied and rip tillage on maize productivity, net crop returns, household income and food security. It also linked to Sub-activity 1.2.2.2: Gender analysis of soil and water conservation technologies. | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10. Gantt chart | 2020 | 2021 | | | | | | | | |
| Activity/ month | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| 1 Participatory planning of rainout shelter with farmers at Mlali |  |  |  |  |  |  |  |  |  |  |
| 2 Rainout site visit for estimation of construction material required |  |  |  |  |  |  |  |  |  |  |
| 3 Land preparation and planting for rainout trial |  |  |  |  |  |  |  |  |  |  |
| 4 Procure rainout shelter materials and agro-inputs (seeds, fertilizers, and pesticides) |  |  |  |  |  |  |  |  |  |  |
| 5 Conduct feedback meeting in all 4 participating villages in Kongwa District |  |  |  |  |  |  |  |  |  |  |
| 6 Installation of rainout structure at maize flowering stage |  |  |  |  |  |  |  |  |  |  |
| 7 Data organization and processing for preparation of manuscript on validation of RTR in semi-arid area of Central Tanzania. |  |  |  |  |  |  |  |  |  |  |
| 8 Draft manuscript, internal review of manuscript developed, and incorporation of comments on validation of RTR in semi-arid area of Central Tanzania. |  |  |  |  |  |  |  |  |  |  |
| 9 Data collection on biophysical variables from rainout shelter experiment |  |  |  |  |  |  |  |  |  |  |
| 10 Implement cultural operation for rainout shelter trial |  |  |  |  |  |  |  |  |  |  |
| 11 Harvesting of rainout shelter trial |  |  |  |  |  |  |  |  |  |  |
| 12 Data processing and preparation of technical reports |  |  |  |  |  |  |  |  |  |  |
| 13 Drafting of manuscript on rainout shelter |  |  |  |  |  |  |  |  |  |  |
| 14 Submission of manuscript on validation of RTR in semi-arid area of Central Tanzania to selected journal |  |  |  |  |  |  |  |  |  |  |
| 15 Uploading of rainout data collected to Dataverse |  |  |  |  |  |  |  |  |  |  |

## Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households)

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| Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households) | | | | |
| a. Output 3.1: | Demand-driven research products to reduce postharvest losses and improve food quality and safety piloted in target areas [and scaled in Outcome 5] | | | |
| b. Activity 3.1.1: | Conduct packaging and delivery of postharvest technologies through community and development partnerships with iterative review, refining, and follow-up | | | |
| c. Sub-activity 3.1.1.1 | Assess the impact of nutritional messaging on farmers' nutritional knowledge, attitude and practices, and household nutrition status, in partnership with Islands of Peace | | | |
|  | | | | |
| d. Research team: | | | | |
| Name | Institution | Role | | |
| Sognigbe N’Danikou | WorldVeg | PI | | |
| Ludovic Joly | Iles de Paix (IDP) | Fund and participate in nutrition training | | |
| Christopher Mutungi | IITA | Participate in post-harvest training for improved nutritional outcomes and participate in data analysis | | |
| NN | IITA/IFPRI | M&E Support | | |
|  | | | | |
| e. Students: Nil | | | | |
|  | | | | |
| f. Locations: | 17 Villages in Karatu: 8 are listed while additional 9 villages will be identified by IDP. Kambi ya samba, Bashay, Buger, Gyekrumlambo, Slahhamo, Rhotia Kainam, Chem, Changarawe | | | |
|  |  | | | |
| g. Start date | January 2019 | | | |
|  |  | | | |
| h. End date | 31 March 2021 | | | |
|  | | | | |
| 1. Justification | | | | |
| Smallholder farmers are also consuming the harvest they produce. Hence, improved knowledge on the nutritional significance of a high diversity of foods will have an immediate impact on their livelihoods. In this context, Ochieng et al. (2016) found that households benefiting from traditional African vegetables (TAV) promotion and demand creation activities had a significantly higher dietary diversity for children under five and women of reproductive age. The integration of dietary diversification with better postharvest management of common staples has the potential for stepping–up the improvements of household nutritional outcomes. Therefore, this intervention will not only introduce various vegetable-based recipes but also encourage the households to eat a more nutritious and diverse diet for healthy living through training while also ensuring better postharvest management of harvested produce. It also aims at influencing key vegetable value chain actors such as the government through the Ministry of Agriculture (MoA), and Ministry of Health and Social Welfare (MOH&SW), and NGOs (RECODA, IDP, MVIWATA). Farm households and food kiosks will be trained on general nutrition guidelines and preparation of nutritious recipes and the impact of nutritional of the training evaluated.  A baseline survey on 489 households was done in Karatu during the 2018/2019 period to assess the impact of nutritional education on farmers' nutritional knowledge, attitude and practices (KAP), income, and household nutrition. The baseline was done in 16 intervention villages. The baseline results show that 30% of households from the intervention villages are not aware of the nutritional value of vegetables and 80% believe that all vegetables contain the same nutrients important for human health and growth. Besides, more than 80% do not know the amount of vegetables and fruits to consume daily. Finally, the households consume a less diversified diet. Dietary diversity is still low with households consuming on average 6 different foods groups with the majority consuming cereal-based foods that have less proteins than e.g., eggs, meat, and fish. Therefore, it is important to train the households in the importance of a diversified diet. First, nutrition training was conducted in 2018/2019 in 8 villages. In 2019/2020 the training will be conducted in the 8 remaining villages to cover all the 16 villages where the baseline was conducted (see study protocols). | | | | |
|  | | | | |
| 2. Objectives | | | | |
| 1. To increase consumption of diverse nutrient-rich foods by poor rural and peri-urban households in Tanzania. 2. To estimate the impact of nutritional education on farmers' nutritional knowledge, attitude and practices (KAP), income, and household nutrition 3. To test uptake of nutritious recipes using model food kiosks/village restaurants | | | | |
|  | | | | |
| 3. Research questions | | | | |
| Has nutritional messaging an impact on farmers' nutritional knowledge, attitude and practices, and household nutrition status? | | | | |
|  | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis:  The nutritional messages developed by Worldveg’s Nutrition-Sensitive Promotion of Vegetables (NutriSenseProm) project in Kakamega Kenya will be adapted to the local situation before training the households and food kiosks in Karatu. The intervention will be done in 16 villages. During 2018/2019 8 villages participated in the training and 332 (160 males and 172 females) households were trained from the first 8 villages. For the intervention areas/villages, the project employs two randomly assigned treatments: (1) Without any nutritional message (control)-10 groups, (2) Nutrition message 1 (M1) and nutrition message 2 (M2)-16 groups. Intervention groups will be provided with seed kits to facilitate the production of vegetables and trained together with WorldVeg and IDP. For ethical reasons, the control group will be provided with seed kits so that the participants receive some input and consequently receive a kind of treatment at the end of the intervention (in 2021). Two sets of messages will be tested. In addition, in 8 villages, 16 food kiosks (2 from each village) were trained on how to prepare different vegetable-based recipes for inclusion in their food menus. The acceptability of the recipes will be evaluated. In 2019/2020, an additional 16 food kiosks (*Mgahawa in Kiswahili*) will be trained. An expanded description of the design is given in the Research protocol. | | | | |
|  | | | | |
| 5. Data (with indicators and metrics) to be collected and uploaded on Dataverse | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/ landscape metrics | Measurement method | | Productivity | | | | | | | Vegetable productivity |  | Kg/ha/season | Kg/ha/season | - | Survey | | Post-harvest loss |  |  | % harvest lost |  | Survey | | Economic | | | | | | | Income diversification index |  | Diversification index (Simpson/ Herfindahl index) | Diversification index (Simpson/ Herfindahl index) |  | Survey | |  | Number of income sources | Number of income sources |  | Survey | | Market participation | - | - | % production sold | total sales | Survey | | Human Condition | | | | | | | Nutrition | - | Availability of diverse vegetable crops (numbers) | Access to nutritious foods  Dietary diversity (24hr recall) | Dietary diversity (24hr recall) | Survey | | Food Security | - | - | Months of food insecurity |  | Focus group discussions (FGD) | | Social | | | | | | | Gender equity |  | Land access by gender  Market participation by gender  Rating of technologies by gender | Land access by gender  Market participation by gender  Rating of technologies by gender |  | Focus group discussions (FGD) | | Collective action |  |  | Participation in a collective action group (% of households in groups) | Number of collective action groups | Key informant interviews (KII)  & FGD | | | | | |
|  | | | | |
| 6. Deliverables: | | | Means of verification | Delivery date |
| At least 350 households trained on nutrition | | | Nutrition training report | March 2021 |
| At least two new vegetable-based recipes developed and promoted (excluding those previously developed by WorldVeg) | | | Recipe report | Jan. 2021 |
| At least four food kiosks/restaurants include recipes in their food menu. | | | Recipe report | Jan. 2021 |
| At least 1 success/blog story | | | Success story online | Mar. 2021 |
| Partners include nutrition education in their existing /new programs | | | Technical report | Mar. 2021 |
|  | | | | |
| 7. How will scaling be achieved? | | | | |
| RECODA and MVIWATA to include nutrition education in their programs in other regions (e.g. in Babati). | | | | |
|  | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | |
| Improved vegetable varieties and good agronomic practices for new traditional African vegetables (TAV) are being scaled by IDP in new villages (sub-activity 5.2.2.3) and IITA post-harvest management activities. | | | | |

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| 9. Gantt chart | | 2020 | | | | 2021 | | |
| Activity/ month | | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
| Community empowerment (Lead: WorldVeg) | 1 Field day |  |  |  |  |  |  |  |
| Backstopping IDP to scale improved management practice in new villages (Lead: IDP) | Participate in awareness creation (vegetable farming as a business (value chain thinking) |  |  |  |  |  |  |  |
| Train IDP staff how to effectively scale out the improved technologies |  |  |  |  |  |  |  |
| Nutrition training in new villages (Lead: WorldVeg) | Nutrition message training |  |  |  |  |  |  |  |
| Train food kiosks on recipe preparation and evaluate recipe acceptability |  |  |  |  |  |  |  |
| Focus groups discussions and Key informant interviews (KII) to assess collective action activities |  |  |  |  |  |  |  |
|  | Survey/FGD to assess/monitor the uptake of nutritious recipes |  |  |  |  |  |  |  |

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| Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households) | | | | | | | | | | |
| a. Output 3.1 | | | Demand-driven research products to reduce postharvest losses and improve food quality and safety piloted in target areas [and scaled in Outcome 5] | | | | | | | |
| b. Activity 3.1.1 | | | Conduct packaging and delivery of postharvest technologies through community and development partnerships with iterative review, refining, and follow-up | | | | | | | |
| c. Sub-activity 3.1.1.2: | | | Evaluate the influence of farmer storage structures and environment on the physical and economic losses abatement by hermetic storage devices | | | | | | | |
|  | | | | | | | | | | |
| d. Systems research team | | | | | | | | | | |
| Name | | | Institution | | | Role | | | | |
| Gundula Fischer | | | IITA | | | Principal investigator, gender analysis | | | | |
| Julius Manda | | | IITA | | | Contribute to the development of survey tool and analysis of socio-economic data | | | | |
| Christopher Mutungi | | | Consultant | | | Draft manuscript on “Differences in nutrition and welfare benefits of improved postharvest practices among men and women in rural Tanzania” | | | | |
|  | | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | | |
|  | | | | | | | | | | |
| f. Location(s) | | | | Babati/ Karatu / Kongwa/ Kiteto Districts | | | | | | |
|  | | | | | | | | | | |
| g. Start | | | | 2018 | | | | | | |
|  | | | | | | | | | | |
| h. End | | | | 2021 | | | | | | |
|  | | | | | | | | | | |
| 1. Justification | | | | | | | | | | |
| This is a continuation of the same activity described in the 2019/2020 workplan which completion was delayed due to COVID-19.  Postharvest loss reduces the food available for consumption and, therefore, has direct impacts on food security, nutrition, and household welfare. Improved technologies for postharvest losses reduction, can help farmers to be more efficient, access better markets, or decrease the number of food deficit days enabling them to switch time and income expenditures to diversify diets or invest in household welfare items depending on context/ typology. Since the Africa RISING inception, improved post-harvest technologies and practices have been exposed to many communities in Tanzania and one often hears many stories from farmers on how they have improved nutrition, resilience, and quality of life. There is a need for a systematic study to measure these benefits within the frame of sustainable intensification and confirm the acceptability of the technologies. In 2018/19, the technical superiority of different air-tight technologies for the storage of maize and beans in contrasting agro-locations was confirmed. There were outright differences in outcomes, which seemed to interest farmers to like some technologies more than others. Technologies will only be attractive to the extent of compelling farmers to invest in them if the perceived benefits substantially offset the costs (directly or indirectly) as opposed to technical superiority alone. Some benefits may be measured in monetary terms, while others may not be measurable as such. This study will generate data to fill this gap by confirming farmer acceptability of the technologies and potential impacts. | | | | | | | | | | |
|  | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | |
| 2.1 To study the gender aspects of different types of air-tight technologies for storage of cereals (maize) and legumes (beans) | | | | | | | | | | |
| 2.2 To assess the impacts of improved postharvest technologies on nutrition, food security, and welfare of farmers in Tanzania. | | | | | | | | | | |
|  | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | |
| 3.1 How do men and women farmers perceive and rate the benefits of different air-tight technologies for cereal and legume grain storage? | | | | | | | | | | |
| 3.2 What are the impacts of using improved postharvest technologies and practices on the nutritional, food security, and welfare of households in Tanzania? | | | | | | | | | | |
| 3.3 Are there potential differences in the achievement of nutrition, food security, and welfare benefits between men, women, and members of different age groups in the household? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | |
| Experiment design, implementation, and data analysis:  This study will be conducted in two parts: The first part will apply focus group discussion, participatory exercises, and key informant interviews to study gender dynamics around the acceptability of different types of air-tight storage technologies by farmers. The gender study will align with the SI indicator framework so that gendered perceptions are captured on all SI domains (Fischer *et al*., 2018[[21]](#footnote-21)). In this part of the study, only farmers who have had experience with the technologies (used the technologies) for at least one postharvest cycle will take part. Data will be transcribed and analyzed using qualitative methods. In the second part, a detailed socio-economic survey will be conducted using structured questionnaires to collect detailed data on demographics, food and non-food expenditure, food security, shocks, and safety nets, among others, from user and non-user households of postharvest technologies. Descriptive statistics and empirical modeling approaches, such as endogenous switching regression analysis will be used in the data analysis. | | | | | | | | | | |
|  | | | | | | | | | | |
| 5. Data (with indicators and metrics) to be collected and uploaded on Dataverse | | | | | | | | | | |
| Domain & *Indicator* | Field/plot level metrics | Farm level metrics | | | Household level metrics | | | Community /landscape metrics | Measurement method | |
| Human | | | | | | | | | | |
| Nutrition |  |  | | | * Household dietary diversity score (HDDS) * Minimum Woman’s * Dietary Diversity Score (MDD-W); * Nutritional status (stunting, underweight, wasting) | | |  | Survey | |
| Food security |  |  | | | * Months of food insecurity * Rating of food security | | |  | Survey | |
| Social | | | | | | | | | | |
| Gender equity |  |  | | | * Nutrition by gender * Food security by gender * Rating of technologies by gender | | |  | Survey, Focus group discussions & participatory exercises | |
|  | | | | | | | | | | |
| 6. Deliverables | | | | | | | Means of verification | | | End date |
| Differences in nutrition and welfare benefits of improved postharvest practices among men and women in rural Tanzania | | | | | | | Report; draft manuscript for publication verified by Chief Scientist | | | Sep. 2021 |
| Gender aspects of food safety in relation to maize | | | | | | | Report | | | Sep. 2021 |
| The role of social capital and networking in relation to the speed of postharvest technology adoption | | | | | | | Report | | |  |
| Collected research data | | | | | | | Data uploaded on Dataverse | | | Sep. 2021 |
|  | | | | | | | | | | |
| 7. How will scaling be achieved? | | | | | | | | | | |
| Partnership with IDP to scale out improved postharvest management technologies and practices to 1,800 new beneficiaries. Furtherance of scaling to be supported through short message service (SMS) on MWANGA Platform. | | | | | | | | | | |
|  | | | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | | | | | |
| This activity is linked to Integrated Soil Fertility Management System activities (1.1.1.6, 1.1.1.7, and 2.2.1.3) that are integrating maize and legume production in Babati and Kongwa, Kiteto. Findings will particularly provide data for human condition domain, nutrition, and food security. | | | | | | | | | | |
|  | | | | | | | | | | |
| 9. Budget | | | | | | | | | | |

|  |  |  |
| --- | --- | --- |
| 3.1.1.2 | Research assistant and consultant | 6,060.00 |
|  | Proofreading and open access fee for one scientific article | 2,300.00 |
| Total |  | 8,360.00 |

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|  | | | | | | | | | | | | |
| 10. Gantt chart | 2020 | | | 2021 | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Data processing and analysis |  |  |  |  |  |  |  |  |  |  |  |  |
| Preparation of scientific article |  |  |  |  |  |  |  |  |  |  |  |  |
| Upload to Dataverse |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 3: Options for equitable food and feed safety, nutritional quality and income security of target smallholder families improved | | | | | |
| a. Output 3.2 | Nutritional quality due to increased accessibility and use of nutrient-dense crops by farmers improved | | | | |
| b. Activity 3.2.1 | Promote and deploy nutrient-rich crop varieties and livestock feed resources in target communities | | | | |
| c. Sub-activity 3.2.1.1 | Elucidate pathways to sustainable adoption of nutrient diets and aflatoxin mitigation practices in rural communities of Central Tanzania | | | | |
|  | | | | | |
| d. Research team | | | | | |
| Name | Institution | | Role | | |
| Patrick Okori | ICRISAT | | PI, Provide leadership in conceptualization to implementation as well as monitoring of activities and reporting to Africa RISING Secretariat. | | |
| Wanjiku Gichohi | ICRISAT | | CoPI, conceptualize and design studies to answer research questions, coordinate assembly of data from both research and monitoring activities, engage with other Africa RISING local and CGIAR partners | | |
| Yacinta Muzanila | SUA | | CoPI, who will implement research and support monitoring activities and responsible for activities implemented by SUA | | |
| Job Kihara | CIAT | | Collaboration on productivity data in different farming systems | | |
| Daniel Mgalla | IITA | | Provide support in monitoring of the research activities to ensure compliance to FtF monitoring system and uploading of data into the FtF data management system | | |
|  | | | | | |
| e. Student(s): Nil | | | | | |
| Name | Institute | | Degree | Start | End |
|  | | | | | |
| f. Location(s)  District, Village | Kongwa, Kiteto | | | | |
|  | | | | | |
| g. Start date | November 2014 | | | | |
|  | | | | | |
| h. End date | August 2021 | | | | |
|  | | | | | |
| 1. Justification | | | | | |
| Nutrition-sensitive agriculture and food systems can contribute to improving nutrition and health outcomes of dependent communities by sustaining the production of diverse, safe, and nutrient-rich food, as well as income generation. It is, therefore, important to determine the capacity of households in the Africa RISING zone of influence to meet their food and nutrition security needs. This will show whether productivity-enhancing and scaling-out initiatives can and or are contributing already to nutrition and health outcomes. It will also inform whether adjustments are needed to better meet dietary needs. This study aims to gain a better understanding of the extent to which rural households in central Tanzania meet their food and nutrient needs from own production and how that is associated with the quality of their diets. It will further investigate whether focus AR crops and their associated commodities have a significant contribution to the nutrition status of households. Some families in the study population have received legumes’ seeds, of legumes, cereals, and poultry and therefore provide a good opportunity as a control group to study adoption behavior. One of the causes of dis-adoption is the seasonality in the availability of certain foods. Additionally, the study will be modified slightly to, “assess the contribution of the farming system interventions in narrowing food and nutrient gaps in Kongwa and Kiteto and the probability of smallholder farmer production to meet them. We will develop food calendars that show the availability of locally sourced foods during the year in the study population. The study, therefore, aims to address household nutrition, a major livelihood issue. It starts with production and the associated technologies being promoted by the different teams as the entry point., which is part of the food system (sub-activity 5.1.1, sub-activity 2.2.1.3, sub-activity 1.1.2.3).  In society, settings in which food supply is sufficient to deliver nutritious and balanced diets, the main impediment to access to such diets by households is usually the income. Households may not be able to decide on affordable diets to meet their energy and nutrient needs even if they know what foods to eat or aspire to eat. Households living in dryland ecologies face this challenge in the form of a double-faced threat, of having very limited food sources during lean months of the year and excess food sources during the main cropping season. This may explain in part, why in dryland ecologies, livelihood risks are often higher, with poor human health and nutrition indicators commonly reported. For such communities, the development of a Food Calendar may address the double challenge of limited food availability or excess food diversity, as it will inform the planning and deployment of interventions to address food supply gaps through post-harvest technologies. A Food Calendar provides information on foods available by season and the cost of accessing them. For a community that also practices livestock rearing such a Food Calendar is also educational and informative, as it can inform the design of scaling-out actions for affordable nutritious diets and therefore support sustained adoption. Previously, we have implemented and/or promoted nutritious diets in Kongwa and Kiteto but noted dis-adoption. | | | | | |
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| 2. Objectives | | | | | |
| 2.1. To study dynamics of access to nutritious foods in agro-pastoral communities of semi-arid agro-ecologies of central Tanzania through the development of food calendars and calculations of the costs of attaining nutritious diets by season. | | | | | |
|  | | | | | |
| 3. Research questions | | | | | |
| 3.1 Does increasing productivity of Africa RISING cereals, legumes and animal products meet dietary diversity and nutrient adequacy of maternal diets? | | | | | |
| 3.2 Does increasing productivity of Africa RISING cereals, legumes and animal products meet dietary diversity and nutrient adequacy of childrens’ diets? | | | | | |
| 3.3 How does the farming system in agro-pastoral communities drive or affect food supply and consumption to meet the dietary demands of especially children, girls, and women? | | | | | |
|  | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | |
| Experiment design, implementation, and data analysis  A cross-sectional study using both qualitative and quantitative data collection methods on dietary intake, foods available both at the household level and markets by season, costs of the foods, and possible combinations of these foods to deliver recommended daily allowance of nutrients to different vulnerable groups. The target population is rural farming communities in two districts of Kongwa and Kiteto. Modified Food Frequency Questionnaires (FFQ) contextualized to the target semi-arid agroecology, will be designed and administered to the target population. An FFQ is a dietary assessment instrument that captures an individual’s usual food consumption by querying the frequency at which a respondent consumes food items based on a predefined food list. Given that food lists are culturally specific, FFQs are adapted and validated for use in different contexts. The existing Africa RISING family research groups and key actors will be the start population to which FFQs will be administered via focused group discussions, key informant interviews, participatory evaluations, and individual surveys. A semi-structured questionnaire will be used to collect data on the seasonal availability of foods mostly from the study population. Furthermore, focus group discussions will be used to validate information collected on food availability and accessibility. Additionally, secondary data available with Africa RISING (baselines, FtF progress indicators, and as applicable, data available in DataVerse) will be used. The data will be subjected to multivariate analysis to identify diet patterns captured using the FFQ using SPSS. The presence of correlations between food groups will be tested using the Bartlett test of sphericity and accepted when it is significant. Subsequently, a Food Calendar will be developed based on seasonality and availability. | | | | | |
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| 5. Data to be collected and uploaded on DataVerse | | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | | Human |  |  |  |  |  | | Nutrition | Protein Production | Total protein production (g/ha) | Access to nutritious food  Food consumption score  Dietary diversity |  | Survey | |  | Total Micronutrient production | Total micro-nutrient production (g/ha)  Availability of diverse food crops | Potential/Actual protein availability |  | Survey  Lookup tables | | Human |  |  |  |  |  | | Food security |  |  | Food availability  Food accessibility  Food utilization  Food security composite index | Total food production | Survey | | | | | | |
|  | | | | | |
| 6. Deliverables | | Means of verification | | Delivery date | |
| 6.1 Food and nutrient gaps in Kongwa/Kiteto under smallholder production systems using Africa RISING technologies established | | Team project report (technical Oct-Mar & April-Sept) submitted to Africa RISING indicating implementation and key results generated  Research Data collected, verified by upload on Dataverse.  FtF data, submitted to the M&E Officer for upload to USAID FtF Platform | | Jun. 2021 | |
| 6.2 Food and nutrient gaps and probability of farmer- increased productivity to meet them by use of new technologies | | Draft manuscript prepared shared with Chief Scientist for internal review | | Aug. 2021 | |
| 7. How will scaling be achieved? | | | | | |
| Through partnerships with non-governmental organizations interested in and implementing nutrition-sensitive specific activities. As a first step to establishing a partnership with WFP (World Food Program) that is already working in Kongwa Kiteto will be made. This will be done after obtaining key results critical for informing scaling-out activities such as the World Food Programme. | | | | | |
|  | | | | | |
| 8. How are the activities in this protocol linked to those of others? See below for the linkages | | | | | |
| These activities are linked to the systems approach for generating evidence on the effect of productivity on nutrition. It will therefore feed into the systems agronomy, Gender, and M&E and have a comprehensive view on the inter-linkages of Agriculture-Nutrition. | | | | | |

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| 9. Gantt chart | 2020 | | 2021 | | | | | | | | | | | |
| Activity/ month | Oct/  Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec |
| Enumerator trainings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Study implementation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data cleanup, analysis, and reporting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Learning and sharing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Draft manuscript from the study prepared |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Outcome 4: Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved

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| Outcome 4: Functionality of markets, institutions, and partnerships associated with SI technologies through providing mechanisms that improve household linkages to markets improved | | | | | | | |
| a. Output4.1 | | Access to profitable markets for smallholder farming communities and priority value chains facilitated | | | | | |
| b. Activity 4.1.1 | | Conduct comprehensive value-chain analysis with specific focus on SI technologies | | | | | |
| c. Sub-activity 4.1.1.2 | | Enhancement of the groundnut seed value chain in central Tanzania: Imperatives for improving functionality | | | | | |
|  | |  | | | | | |
| d. Research team | | | | | | | |
| Name | | Institution | | Role | | | |
| Patrick Okori | | ICRISAT | | PI, coordinate assembly of data from both research and monitoring activities, engage with other Africa RISING local and CGIAR partners | | | |
| James Mwololo | | ICRISAT | | CoPI, support the development of tools and assembly of data from both research and monitoring activities, engage with other Africa RISING local and CGIAR partners | | | |
| Julius Manda | | IITA | | CoPI, support assembly of data from both research and monitoring activities, engage with other Africa RISING local and CGIAR partners | | | |
| Daniel Mgalla | | IITA | | To provide support in monitoring of the research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and custom indicators data) with critical gender perspective, and uploading of data into the FtF data management system | | | |
| Extension officers | | DAICOs-Iringa, Kiteto, Kongwa | | Support the survey teams (enumerators) as appropriate | | | |
|  | | | | | | | |
| e. Student(s): Nil | | | | | | | |
|  | | | | | | | |
| f. Location(s) | | Kongwa, Kiteto | | | | | |
|  | | | | | | | |
| g. Start date | | May 2021 | | | | | |
|  | | | | | | | |
| h. End date | | September 2021 | | | | | |
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| 1. Justification | | | | | | | |
| In 2019, our team conducted a groundnut seed value chain analysis, that mapped segments of the chain and identified key actors and their roles. The study found that smallholder farmers were finding opportunities in seed value chain activities. However, more inclusive engagement is needed for greater beneficiary access by farmers and other value chain actors. In a previous study (Fahd Majeed *et al*., 2018[[22]](#footnote-22)), IFPRI reported that Dodoma and Manyara regions have the highest amount of land dedicated to groundnut production by smallholders at 0.64 ha and 0.59 ha respectively. These smallholder farmers could be mobilized to produce high-grade seeds. But the markets must be inclusive and beneficial, underscoring the need for inclusive approaches in value chain strengthening. Our just completed value chain study adds value to the IFPRI report on critical value chains, especially of groundnut, by focusing on the seed production-to-delivery segment of the entire groundnut value chain. For an inclusive upgrade of the seed value chain, it is important that interventions harness marketsin ways that include smallholder farmers and at the same time, reduce production to market risks including building their resilience.  Whereas the just-completed study identified several bottlenecks impeding the proper functioning of the groundnut seed value chain in central Tanzania and the actions needed for upgrading, it did not link the functioning of upgrading the processes with beneficial outcomes of resilience and participation in rewarding markets by smallholder farmers. It is, therefore, proposed to address this gap by developing a strategy to guide future actions on improving groundnut seed value chains in central Tanzania. The strategy will cover improved access to basic seed, credit and other financial services, markets and competitiveness, and agricultural extension for seed production. These issues are important for the creation of a vibrant groundnut seed value chain, a segment within the broader groundnut value chain, that is currently underinvested especially by the private sector.  This study to identify upgrade options necessary for the development of an inclusive groundnut seed value chain will be supported by the Africa RISING Economist. The study outcomes will inform the development of a groundnut seed value enhancement strategy in readiness for operationalization. A separate report with more details was submitted with the details and a draft Manuscript (includes maize and groundnut) seed value chains is under preparation. | | | | | | | |
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| 2. Objectives | | | | | | | |
| 2.1 To develop a groundnut seed value enhancement strategy in readiness for its operationalization to unlock its potential for an inclusive engagement of smallholder farmers of especially Manyara and Dodoma key groundnut producing regions of Tanzania | | | | | | | |
|  | | | | | | | |
| 3. Research questions | | | | | | | |
| 3.1 What strategic interventions and business linkages are inclusive enough to improve benefit flow to seed producers and at the same time increase production demand for seed in the groundnut seed value chain for central Tanzania? | | | | | | | |
|  | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | |
| Experiment design, implementation, and data analysis  The study will be conducted in central Tanzania, in the Africa RISING focus districts of Kongwa and Kiteto. The study population comprises different segment actors of the groundnut seed value chain (demand and supply), as well as political economy actors such as policymakers, that influence operation contexts of the focus seed value chain. The first step of the study will be the completion and refining of a diagnostic tool whose composition will be framed by major results from the 2019 groundnut value chain analysis. This diagnostic framework, when completed, will address key questions concerning: Defining the groundnut seed value chain transformation process; Identification of main inputs/actions needed for the transformation process; Assessment of key resources required to complete the process; Characterization of partnership networks, and linkages between critical actors for delivery of products and services, among others. The second part of the study will focus on the validation and generation of strategic interventions by critical stakeholders. The team will hold stakeholder meetings that may use focus group discussions and key informant interviews herein referred to as dialogue tables. Dialogue tables provide the opportunity to discuss collective mitigation action areas for identified bottlenecks of the groundnut seed value chain. It will thus ensure collaborative engagement, an important foundation for implementation designing of the upgrade strategy for the target value chain. It will also stimulate the exchange of ideas and derive courses of action for upgrading the seed value chain stimulation. | | | | | | | |
|  | | | | | | | |
| 5. Data to be collected and uploaded on DataVerse | | | | | | | |
| Domain and *Indicator* | Field/plot level metrics | | | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | |
| Economic | | | | | | | |
| Market participation | N/A | | | % production sold | Total sales | Survey | |
| Market orientation |  | | | % land in cash crops  Market orientation index |  | Survey | |
| Social | | | | | | | |
| Social cohesion | Participation in community activities | | | Participation in community activities | Social groups, Participation in social groups | Key informant interviews,  Focus group discussions | |
| Equity | Access to resources, capacity (access to information); Achievements (income, nutrition) | | | Access to resources, capacity (access to information); Achievements (income, nutrition) |  | Key informant interviews,  Focus group discussions | |
| Collective action | Participation in collective action group | | | Participation in collective action group | Collective action groups  Capacity of groups | Household survey  Focus group discussions | |
| Human condition | | | | | | | |
| Capacity to experiment |  | | | No. of new practices being tested |  | Focus group discussion | |
|  | | | | | | | |
| 6. Deliverables | | | Means of verification | | | | Delivery date |
| 6.1 Critical information to inform the design of effective and efficient investments towards making the groundnut seed value chain more responsive and profitable. | | | Draft manuscript prepared shared with Chief Scientist for internal review and submitted for publication in May 2021 | | | | Apr - May 2021 |
| Study report for the proposed work | | | | Jul. 2021 |
| Draft manuscript prepared shared with Chief Scientist for internal review | | | | Sep. 2021 |
| 6.2 Candidate partnerships identified for post research negotiation on implementation of value chain upgrade involving key stakeholder (government, private sector, development partners) | | | Team progress report (technical Oct-Mar & April-Sept) submitted to Africa RISING secretariat indicating steps taken to identify partnerships for improving the functionality of groundnut seed value chain.  FtF data, submitted to the M&E Officer for upload to USAID FtF Platform | | | | Sep. 2021 |

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| 7. How will scaling be achieved? |
| The strategy for improving the functionality of the groundnut seed value chain will clarify the steps to take in the generation of common action areas key stakeholders. We envisage strategic partnerships with government, private sector, and development partners as the key implementors of the value chain upgrade. |
|  |
| 8. How are the activities in this protocol linked to those of others? |
| The proposed work aims to improve access to seed but has multi-dimensional areas of economics and markets as well as sociology. The activity involves Africa RISING team socio-economists (economics and gender-sociology). |

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| 9. Gantt chart | | | | | | | | | | | | | | | |
|  | 2020 | | 2021 | | | | | | | | | | | | |
| Activity/ month | Oct/Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec |
| Diagnostic tool development and pre-testing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Implementation-Focused group discussions/surveys |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis and reporting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Draft Manuscript from the study prepared |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Learning and sharing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 4: Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved | | | | | | | | | | | | | | |
| a. Output 4.1 | Access to profitable markets for smallholder farming communities and priority value chains facilitated | | | | | | | | | | | | | |
| b. Activity 4.1.1 | Conduct comprehensive value-chain analysis with specific focus on SI technologies | | | | | | | | | | | | | |
| c. Sub-activity 4.1.1.3 | Assess how ISFM practices affect farmers’ livelihoods as a result of Africa RISING activities in Babati | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | Institution | | Role | | | | | | | | | | | |
| Job Kihara | CIAT | | PI | | | | | | | | | | | |
| Jonas Julius/Rose Anael | MoA | | Coordinate with village extension and local leaders for safe conduct of in-depth surveys | | | | | | | | | | | |
| Prosper Massawe | TARI-Selian | | Supervise enumerators conducting household surveys | | | | | | | | | | | |
| Julius Manda | IITA | | Provide technical review and critic of the survey tool to ensure compliance with requirements for outcome 5 of Africa RISING | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| f. Location(s) | Long, Seloto, Sabilo, and Gallapo in Babati District, Tanzania | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start date | December 2013 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| h. End date | November 2021 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| Africa RISING has tested and demonstrated ISFM practices in Babati, Tanzania since 2013/2014. It is important to understand how these practices have been taken up by farmers, the extent of use by these farmers, and implications to key household level indicators including incomes and nutrition. Activities implemented previously related to the ISFM include linking farmers to input suppliers (improved seeds) and output markets through collective action. Farmers were also exposed to ISFM at different degrees including participation in demonstration trials, farmer field days, implementation of ISFM baby trials, farmer evaluation of technologies, hand-outs, and coupon farmers. The farmers themselves are of different wealth categories. This activity will help us understand the uptake of ISFM while considering these different contexts including the agro-ecological settings. Before the ISFM tests and demonstrations, an agronomic survey was conducted that can serve as an important baseline. This activity will unravel farmers motivation to invest or not invest in ISFM, the key challenges and identify opportunities.  Besides ISFM, Africa RISING has implemented and exposed farmers to other interventions related to the maize value chain. This is because the maize value chain is often fragmented and poorly coordinated with many layers and inefficient connections between producers and consumers. To overcome some of these problems, the Africa RISING project has been promoting the use of improved inputs such maize seed and inorganic fertilizers, improving access to these inputs, validating and promoting GAPs, encouraging the use of improved postharvest technologies such as tarpaulins, maize shelling machines, airtight storage containers, etc., linking farmers to profitable markets and encouraging cooperation amongst farmers to enable collective action for them to lower transaction costs and access better markets. We will assess how the various value chain interventions contribute to the upgrading of the maize value chain including generating the lacking evidence showing the effect of cooperation and collective action. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | |
| 2.1 To evaluate the uptake of ISFM by participating farmers and quantify the associated household-level benefits of implementing ISFM and identify opportunities and challenges to increase adoption. | | | | | | | | | | | | | | |
| 2.2 To assess the impact of Africa RISING interventions in the upgrading of the maize value chain in Babati, focusing on SIAF domains. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | |
| 3.1 To what extent are farmers implementing ISFM and what are the key determining factors  What is the impact of extent of ISFM use on household level indicators of income, food, and nutritional security? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| Experiment design, implementation, and data analysis: The data for this study will come from a larger maize value chain survey which will be conducted in Babati district consisting of 600 farmers.  The households will consist of maize producers as well as ISFM adopters bearing in mind the representation of women and youth farmers. Of the total of 600 households, 300 farmers will be purposively selected from those exposed to ISFM by the project covering at least 6 villages across four main ecozones of Babati. The survey will consist of an agronomic component with yield cuts in portions of farmer fields following the model used in Kihara *et al*., 2014[[23]](#footnote-23) (available [here](https://www.researchgate.net/publication/267338611_Agronomic_survey_to_assess_crop_yield_controlling_factors_and_management_implications_a_case-study_of_Babati_in_northern_Tanzania)) plus an additional component to understanding the overall household-level benefits and implications of ISFM, the expansion of ISFM, and the driving factors for these. These households will be purposively selected because it is a follow-up survey on the one conducted 2014 (see Kihara *et al*., 2014[[24]](#footnote-24)). The maize value chain survey tool will include information similar to the tool appended below specifically to capture data on agronomy. The other 300 households will be randomly selected through a stratified random sampling procedure. Similar data will be obtained as explained above but without the yield cuts from farmers’ fields. Data relating to the maize value chain e.g. maize production, marketing, and processing will be collected from all the 600 farmers. Besides, the survey will also collect information on collective action and farmers’ business relationships with input suppliers and traders/processors. Finally, the data collected will be analyzed considering levels of exposure/training, group participation e.g., through collective action. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on Dataverse | | | | | | | | | | | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | | Productivity |  |  |  |  |  | | Crop productivity | Maize, beans, pigeon pea productivity (kg/ha/season), and any other crop in system |  |  |  | Yield measurements | | Variability of production | Coefficient of variations by ISFM use |  | Rating of production risk | Variability of production¥ | Yield measurements/  Survey | | Biomass productivity | Maize, beans, pigeon pea biomass productivity (kg/ha/season), and any other crops |  |  |  | Yield measurements | | Economic |  |  |  |  |  | | Profitability | Gross margins ($/ha/ season)—aggregate for all crops in system | Gross margins ($/ha/ season) |  | (potential) Contribution to  regional or national  GDP | Yield measurements/  Survey | | Labor requirement | Labor requirement (hours/ha) |  | Farmer rating of labor |  | Survey | | Variability of profitability |  |  | Probability of low profitability |  | Yield measurements | | Market participation |  |  | % production sold |  | Survey | | Environmental | | | | | | | Fuel availability | Fuel biomass (kg/ha/season) |  | # months energy security | Diversity of fuel sources£  Spatial arrangement of fuel sources | Measurements/  Survey | | Erosion | Rating of erosion |  |  | Extent/variation of soil conservation measure under useµ | Survey | | Soil Biology | Labile or ‘active’ carbon  (POXC) |  |  |  | Soil tests | | Soil quality | Soil organic carbon and total N |  |  | Nutrient partial balance | Soil tests | | Human condition | | | | | | | Nutrition | Protein production (g/ha) |  |  |  | Field measurement/ lookup tables | | Food security | Food production (calories/ha/year) |  | Months of food insecurity; Rating of food security |  | Field measurement/ lookup tables/  Survey | | Social | | | | | | | Gender equity |  |  | Time allocation by gender |  | Household survey | |  |  | Management control by gender |  | Household survey | | Income by gender |  | Income by gender |  | Household survey | | Equity |  |  | Capacity (access to information) |  | Household survey | |  |  |  | Access to resources (land and livestock ownership) a |  | Household survey | | Collective action |  |  | Participation in a collective action group |  | Household survey | | | | | | | | | | | | | | | |
| £ we are introducing this. Understanding fuel sources at the household/community level is important to inform strengthening the promotion of alternative systems to save on environmental destruction i.e., vegetation clearing.  ¥ we want to know how ISFM intensity affects crop production variability at the community level.  µ we want to understand the soil and water conservation measures under use at the community level as a component of ISFM adaptation  NB: access to information and resources and participation in collective action will be considered required variables to explain the successes of ISFM | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 6. Deliverables | | | | | Means of verification | | | | | | Delivery date | | | |
| 6.1 10 enumerators trained | | | | | Training report | | | | | | April. 2021 | | | |
| 6.2 Draft publication summarizing survey data | | | | | Draft article shared with Chief Scientist | | | | | | Oct. 2021 | | | |
|  | | | | | | | | | | | | | | |
| 7. How will scaling be achieved? | | | | | | | | | | | | | | |
| We are working in partnership with the Ministry of Agriculture Babati in an ongoing collaboration. The project supports participation in Nane-Nane exhibitions where key messages of our work are communicated. Besides, we developed a field guide that shows different best agronomic practices including implementation of ISFM practices. We intend to continue translating key results of our work into key messages through blogs but also utilize Mwanga ICT platform to communicate agronomic information. We will consider adding farmers participating in the survey under this activity into those already enlisted in Mwanga and receiving agronomic messages. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How are activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
| This activity is targeted to provide data in response to outcome 4 of the Africa RISING. It, therefore, links and contributes to the work by Julius Manda. We continue to assess biomass productivity which is a component also for livestock. Our approach of assessing the impact of ISFM applies to other sites e.g. Kongwa/Kiteto, and we want to know whether a similar approach and protocol can be applied there also. We are utilizing Mwanga ICT, a tool developed within Africa RISING. | | | | | | | | | | | | | | |
| 9. Gantt chart | | 2020 | 2021 | | | | | | | | | | | |
| Activity/ month | | Dec | Jan | Feb | | Mar | Apr | May | Jun | Jul | | Aug | Sep | Oct |
| Development of survey tool | |  |  |  | |  |  |  |  |  | |  |  |  |
| Training of enumerators | |  |  |  | |  |  |  |  |  | |  |  |  |
| Pretesting of the survey tool | |  |  |  | |  |  |  |  |  | |  |  |  |
| Collecting data through survey | |  |  |  | |  |  |  |  |  | |  |  |  |
| Data organization and cleaning | |  |  |  | |  |  |  |  |  | |  |  |  |
| Analysis of the survey data | |  |  |  | |  |  |  |  |  | |  |  |  |
| Developing draft manuscript from survey data | |  |  |  | |  |  |  |  |  | |  |  |  |
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| Outcome 4: Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved | | | | | | | | | | | | | | |
| a. Output 4.1 | Access to profitable markets for smallholder farming communities and priority value chains facilitated | | | | | | | | | | | | | |
| b. Activity 4.1.1 | Conduct comprehensive value-chain analysis with specific focus on SI technologies | | | | | | | | | | | | | |
| c. Sub-activity 4.1.1.4 | Assess how the implementation of ISFM practices affect farmers’ livelihoods because of Africa RISING activities in Kongwa | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | Institution | | | Role | | | | | | | | | | |
| Elirehema Swai | TARI Hombolo | | | Overall supervision on data collection in Kiteto and Kongwa District | | | | | | | | | | |
| Job Kihara | CIAT | | | Providing technical backstopping on tools for data collection, processing, and analysis | | | | | | | | | | |
| Jackson Shija | Kongwa District Council | | | Coordination with village extension and local leaders for safe conduct of in-depth surveys | | | | | | | | | | |
| Devotha Mchau | TARI Makutupora | | | Supervising enumerators conducting household surveys | | | | | | | | | | |
| Julius Manda | IITA | | | Providing technical review and critic of the survey tool to ensure compliance with requirements for outcome 5 of Africa RISING | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| f. Location(s): | Mlali, Nghumbi, Sagara na Laikala | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| g. Start date | November 2020 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| h. End date | November 2021 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| Africa RISING has tested and demonstrated integrated soil fertility management (ISFM) practices in the Kongwa District, Tanzania, since the 2013/2014 cropping season to date. At this juncture, it is of critical importance to understand how these practices have been taken by farmers, the extent of use by these farmers, and the implications to key household level indicators, notably income and nutrition. Activities implemented previously related to the ISFM included the use of improved seeds (maize/sorghum), fertilizers, implementation of tied ridging, Fanya juu/chini terraces, among others. Farmers across participating villages were exposed to the ISFM technologies at varying degrees as a sound strategy for conserving the natural resource base in erosion-prone areas of central Tanzania. These included participation in demonstrations, farmer field days and implementation of ISFM baby trials, onsite training to strengthen farmers’ knowledge, and rollout of Fanya juu/chini terraces and tied ridging technologies. The resource endowment for farmers using ISFM technologies across the study area are of different categories. Therefore, the proposed study during the 2020/2021 cropping season will understand the extent of ISFM use and benefits while considering the different contexts of exposure, resource endowments, and the agro-ecological settings. The proposed study will gauge to what extent farmers are motivated to invest or not invest in ISFM technologies introduced and rolled and the associated key challenges for further improvement. | | | | | | | | | | | | | | |
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| 2. Objective | | | | | | | | | | | | | | |
| 2.1 To quantify household-level benefits of implementing ISFM technologies/practices and identify opportunities and challenges to increase adoption | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | |
| 3.1 To what extent are farmers implementing ISFM technologies/practices and what are the key determining factors? | | | | | | | | | | | | | | |
| 3.2 What is the impact of extent of ISFM use on household level indicators of income, food, and nutritional security? | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| Experiment design, implementation, and data analysis  This study will be a detailed survey with at least 300 farmers (purposively selected from those exposed to ISFM by the project) covering at least three villages covering sorghum/pearl millet-based cereal systems and maize-based cereal system in semi-arid areas of Kongwa district. The survey will consist of an agronomic survey with yield cuts in portions of farmer fields following the model used in Kihara *et al*. 2014[[25]](#footnote-25) plus an additional component to understand the overall household levels benefits and implications of ISFM, the expansion of ISFM, and the driving factors for these. The agronomic survey tool that will be adapted and expanded for this is appended below. The 300 farmers will be selected considering the representation of women and youth farmers. Data collected will be analyzed while taking into account levels of exposure/training, group participation e.g., through collective action. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 5. Data to be collected and uploaded on DataVerse | | | | | | | | | | | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | | Productivity | | | | | | | Crop productivity | Maize productivity (kg/ha/season) and any other crop in system |  |  |  | Yield measurements | | Variability of production | Coefficient of variations by ISFM use |  | Rating of production risk | Variability of production¥ | Yield measurements  Survey | | Biomass productivity | Maize, beans, pigeon pea biomass productivity (kg/ha/season) and any other crops |  |  |  | Yield measurements | | Economic | | | | | | | Profitability | Gross margins ($/ha/ season)—aggregate for all crops in system | Gross margins ($/ha/ season) |  | (potential) Contribution to  regional or national  GDP | Yield measurements  Survey | | Labor requirement | Labor requirement (hours/ha) |  | Farmer rating of labor |  | Survey | | Variability of profitability |  |  | Probability of low profitability |  | Yield measurements | | Market participation |  |  | % production sold |  | Survey | | Environmental | | | | | | | Erosion | Rating of erosion |  |  | Extent/variation of soil conservation measure under useµ | Survey | | Soil Biology | Labile or ‘active’ carbon  (POXC) |  |  |  | Soil tests | | Soil quality | Soil organic carbon and Total N. |  |  | Nutrient partial balance | Soil tests | | Human condition | | | | | | | Nutrition | Protein production (g/ha) |  |  |  | Field measurement/ lookup tables | | Food security | Food production (calories/ha/year) |  | Months of food insecurity; Rating of food security |  | Field measurement/ lookup tables  Survey | | Social | | | | | | | Gender equity |  |  | Time allocation by gender |  | Key informant interviews | |  |  | Management control by gender |  | Key informant interviews | | Income by gender |  | Income by gender |  | Key informant interviews | | Equity (generally) |  |  | Capacity (access to information) |  | Household survey | |  |  |  | Access to resources (land and livestock ownership) a |  | Household survey | | Collective action |  |  | Participation in a collective action group |  | Household survey | | | | | | | | | | | | | | | |
| £  we are introducing this. Understanding fuel sources at household/community level is important to inform strengthening the promotion of alternative systems to save on environmental destruction i.e., vegetation clearing.  ¥ we want to know how ISFM intensity affects variability of crop production at the community level.  µ we want to understand the soil and water conservation measures under use at the community level as a component of ISFM adaptation  NB: access to information and resources as well as participation in collective action will be required as variables to explain the successes of ISFM | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 6. Deliverables | | | Means of verification | | | | | | | | Delivery date | | | |
| 6.1 Ten enumerators trained | | | Training report submitted to project communication officer for uploading in website | | | | | | | | Apr. 2021 | | | |
| 6.2 Draft publication summarizing survey data | | | Draft article shared with Chief Scientist | | | | | | | | Oct. 2021 | | | |
|  | | | | | | | | | | | | | | |
| 7. How will scaling be achieved? | | | | | | | | | | | | | | |
| We are working in partnership with the local government i.e. district council in an ongoing collaboration. The project supports participation in NaneNane exhibitions where key messages of our work are communicated. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How are activities in this protocol linked to those of others? | | | | | | | | | | | | | | |
| This activity is targeted to provide data in response to outcome 4 of the Africa RISING. It, therefore, links and contributes to the work by Julius Manda. We continue to assess biomass productivity which is a component also for livestock. Our approach of assessing the impact of ISFM is similar to other sites such as planned studies in Babati and Kongwa district councils this allows for cross-site learning’s under different agro-ecologies. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 9. Gantt chart | | 2020 | | | 2021 | | | | | | | | | |
| Activity/ month | | Dec | | | Jan | Feb | Mar | Apr | May | Jun | | Jul | Aug | Sep |
| Development of survey tool | |  | | |  |  |  |  |  |  | |  |  |  |
| Training of enumerators | |  | | |  |  |  |  |  |  | |  |  |  |
| Pretesting of the survey tool | |  | | |  |  |  |  |  |  | |  |  |  |
| Collecting data through survey | |  | | |  |  |  |  |  |  | |  |  |  |
| Data organization and cleaning | |  | | |  |  |  |  |  |  | |  |  |  |
| Analysis of the survey data | |  | | |  |  |  |  |  |  | |  |  |  |
| Developing draft manuscript from survey data | |  | | |  |  |  |  |  |  | |  |  |  |
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| Outcome 4. Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved | | | | |
| a. Output 4 | Access to profitable markets for smallholder farming communities and priority value chains facilitated | | | |
| b. Activity 4.1.1 | Conduct comprehensive value-chain analysis with specific focus on SI technologies | | | |
| c. Sub-activity 4.1.1.5 | Value chain analysis of nutrient-dense common bean varieties in Malawi | | | |
|  | | | | |
| d. Research team | | | | |
| Name | Institution | | Role | |
| Rowland Chirwa | CIAT | | Research design, data collection, and report writing | |
| Julius Manda | IITA | | Research design, data collection | |
| Regis Chikowo | MSU | | Research design, data collection, and report writing | |
|  | | | | |
| e. Student(s): Nil | | | | |
|  | | | | |
| f. Location(s) | Lilongwe, Ntchisi, Dedza EPAs | | | |
|  | | | | |
| g. Start date | This is a follow-on study of previous common bean integration studies implemented by CIAT (Sub-activity 3.2.1.2 Promote farmer production of nutrient-dense (Zn, Fe) SER83 and NUA45 bean varieties) | | | |
|  | | | | |
| h. End date | September 2021 | | | |
|  | | | | |
| 1. Justification | | | | |
| Micronutrient malnutrition caused by iron, iodine, vitamin A, and zinc deficiencies is one of the most important factors resulting in high mortality rates among children under five years of age, pregnant women, and lactating mothers in developing countries. In Malawi, on average 37% of the children are stunted and the occurrence of anemia in children aged 6 – 59 months is about 64%. Coupled with this, about 20% of pregnant women, are anemic. Common beans offer considerable promise in overcoming malnutrition due to their high protein and iron content. Moreover, recent advances in research have made it possible to increase micronutrient content in beans through bio-fortification. To this end, CIAT in collaboration with the Malawi national agricultural research system, released the biofortified common bean variety, NUA45, in 2016. The bean variety is biofortified with zinc and iron to address the public health issues mentioned above. The variety was also bred for marketability by ensuring large kernel size and red mottled attributes. NUA45 is an early maturing and high-yielding variety that can adapt to the changing climate. Although efforts have been made to promote and commercialize NUA45, there has not been a comprehensive study that has analyzed the opportunities and constraints that exists along the NUA45 common bean value chain. To the extent that this variety was also developed with the market in mind, examining whether farmers growing NUA45 obtain a premium price for their produce is also important. The key objective of the study is, therefore, to carry out a comprehensive mapping and value chain analysis of the bean subsector, with a special focus on NUA45 common bean variety in Malawi. | | | | |
|  | | | | |
| 2. Objectives | | | | |
| 2.1 To map different players in the biofortified common bean value chain.  2.2 To determine the efficiency of the biofortified common bean value chain.  2.3 To identify bottlenecks and opportunities in the biofortified common bean value chain | | | | |
|  | | | | |
| 3. Research questions | | | | |
| 3.1 Who are the major actors in the biofortified common bean value chain?  3.2 What are the production and marketing channels for biofortified common beans including costs and margins?  3.3 What opportunities and constraints exist along the biofortified common value chain?  3.4 What is the market share of NUA45 compared to other improved and local common bean varieties? | | | | |
|  | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis  The data in this study will come from both secondary and primary data sources. The secondary data will be obtained from the Ministry of Agriculture, Irrigation and Water Development and the Malawi National Statistics Office (NSO). The primary data will be obtained through interviews with actors at each stage of the value chain (input supply, production (farmers), assembling, and marketing) in the common bean producing areas of Dedza and particularly in Linthipe where Africa RISING introduced NUA45. The Lilongwe Ntchisi common bean market will be also central to this study. About 150 farmers will be selected randomly from a pool of common bean farmers in Lithipe. Key informant interviews will also be conducted to collect information from input suppliers, large-scale traders, exporters, and service providers that support the value chain. Hence, structured questionnaires and checklists will be designed for each of the actors and will be administered by well-trained enumerators.  Finally, data will be analyzed using Stata and SPSS software. Specifically, value chain maps showing the direction of flow of biofortified common beans and products from production all the way to consumption will be developed. Second, specialized indices such as the Herfindahl-Hirschman Index (HHI), Marketing Efficiency Index (MEI), and Marketing Margins will be used to assess the efficiency of the biofortified common bean value chain. Finally, opportunities and constraints will be identified and upgrading options for a more inclusive value chain will be developed. | | | | |
|  | | | | |
| 5. Data (with metrics) to be collected and uploaded on DataVerse | | | | |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community /landscape metrics | Measurement method | Responsible | | Productivity | | | | | |  | | Common bean grain productivity | bean grain yield (kg/ha/season) |  |  |  | Survey | MSU | | Economic | | | | | |  | | Profitability | Net income ($/crop/ha/season);  Gross margin |  |  | Market participation (% share) | Survey | IITA/MSU | | Human condition | | | | | | MSU | | Nutrition | Protein production (kg/ha); Zn and Fe production (g/ha) |  |  |  | Lookup tables | MSU | | Food security | Food production  (calories/ha/year) |  | Months of food insecurity |  | Lookup tables, survey | MSU | | Social | | | | | |  | | Gender equity | Rating of technologies by gender |  |  |  | Participatory evaluation | MSU | | Social cohesion |  |  | Participation in community activities |  | Focus group discussions |  | | | | | |
|  | | | | |
| 6. Deliverables | | Means of verification | | Delivery date |
| 6.1 Detailed protocol finalized | | Data collection protocol available | | Dec. 2020 |
| 6.2 Data sets by different value chain players | | Excel files, raw field data | | Jun. 2021 |
| 6.3 Data combined and uploaded on DataVerse | | Data files, reports | | Sep. 2021 |
| 6.4 Value chain report | | Report submitted to IITA | | Sep. 2021 |
| 6.5 Scientific publication (draft) | | Manuscript available and shared with chief scientist for finalization | | Sep. 2021 |
|  | | | | |
| 7. How will scaling be achieved? | | | | |
| Scientific publication in an appropriate social science/economics journal | | | | |
|  | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | |
| Farmers will be selected from those that previously implemented research with CIAT | | | | |
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|  | | | | | | | |
| 9. Gant hart | 2020 | 2021 | | | | | |
|  | Nov/Dec | Jan | Feb/Mar | Apr | May | Jun/Jul | Aug/Sep |
| Sampling farmers for the study in Linthipe |  |  |  |  |  |  |  |
| Designing data collection tools |  |  |  |  |  |  |  |
| Mapping common bean stakeholders along the value chain (seed providers, fertilizers, chemicals, buyers, etc.) |  |  |  |  |  |  |  |
| Survey of common bean production practices, varieties produced, quantities, local consumption |  |  |  |  |  |  |  |
| Marketing study during the common bean marketing season (local markets/Dedza markets/Lilongwe markets |  |  |  |  |  |  |  |
| Data analysis, scientific manuscript development, and report writing |  |  |  |  |  |  |  |
| DataVerse data upload |  |  |  |  |  |  |  |
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## Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized

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| Project Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | |
| a. Output 5.1: | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | |
| b. Activity 5.1.1: | Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations | | | |
| c. Sub-activity 5.1.1.1: | Continued experimentation in 6 target communities of Eastern Zambia and 10 target communities in central and southern Malawi with already established clustered CA trials | | | |
|  |  | | | |
| d. Systems research team: | | | | |
| Name | Institution | | Role | |
| Christian Thierfelder | CIMMYT | | PI, design, agronomic assessment | |
| Consultant | IITA | | Socio-economic linkage to agronomic work (Level of effort 20 consultancy days) | |
| Julius Manda | IITA | | Socio-economic research | |
| Richard Museka | TLC | | Implementation and scaling | |
| Mphatso Gama | Machinga ADD | | Implementation and scaling | |
| Mulundu Mwila | ZARI | | Implementation and scaling | |
|  | | | | |
| e. Student(s): Nil | | | | |
|  |  | | | |
| f. Location(s): | Hoya, Vuu, Kapara, Mtaya, Chanje, Kawalala in Eastern Zambia  Mwansambo, Zidyana, Chinguluwe, Chipeni, Linga, Lemu, Herbert, Malula, Matandika, Songani in Malawi | | | |
| g. Start date | This is a continuing multi-year study that has been running since 2011 in Zambia and since 2004/2005 in Southern and Central Malawi | | | |
|  |  | | | |
| h. End date | November 2021 | | | |
|  | | | | |
| 1. Justification | | | | |
| Smallholder farmers in southern Africa are affected by climate change and soil fertility decline and this was the primary reason for establishing CA long-term trials. Throughout the years these trials have evolved from simple CA systems trials to more sophisticated CA long-term trials with maize doubled-up legumes. Our justification for continuing these trials despite a stronger focus on socio-economic aspects needed for the last year:   * Due to the long-term nature of these trials, we can reasonably expect that some of the soil quality indicators (infiltration and soil chemical properties) have evolved and can now be analyzed in form of a final assessment. We would lose a great deal of high-quality scientific information as some of these sites are more than 16 years old and this is unique in Africa. This will also help us assess the resilience of the CA technologies investigated in these long-term trials. * Since the last two years, we have modified the trials to have a maize-doubled-up legume rotation based on recommended technology interactions with MSU, our implementing partner in Malawi. We have not yet seen the full benefit of this technology strategy in terms of % yield increase, increase in the nutritional value of the whole system, % carbon increase, internal rate of return (in USD), returns to investment (in USD) amongst others as we only have two years of data. This requires the last year of research and data taking. * The long-term on-farm sites are further required to serve as an anchoring point to conduct remaining research on profitability (e.g. longer-term economic benefits), technological choice by farmers, and human impacts, which have been jointly planned with socio-economist for this last year. The argument is that they cannot do this kind of research without a context-specific geographic location where they can do the research. * Finally, the long-term on-farm sites are our direct link with the development partners from both public and private sector extension. These infection points not only serve as learning grounds, places for technology evaluation, and field day activities – they are also prestigious to the Ministry of Agriculture staff as they fully own them and can be used as reference points in their work.   The proposed emphasis is on closing identified knowledge gaps in the logframe in the environmental, social, economic, and human domains while maintaining the on-farm long-term trials as anchoring points for this research. In collaboration with the IITA regional scientist the impact of technological interventions will be further assessed in an impact study to contribute to the final project report (e.g. we will gather returns on investment, yield increase per investment, calorie/protein benefits amongst others). | | | | |
|  | | | | |
| 2. Objectives | | | | |
| To demonstrate the best options available for the management of drought-tolerant maize varieties and conservation agriculture practices in 16 target communities of Malawi and Zambia. Conservation agriculture is understood to imply surface crop residue retention, minimum soil disturbance, and crop rotation. Both animal traction and manual systems will be tested. | | | | |
|  | | | | |
| 3. Research questions | | | | |
| * How can CA and associated practices increase food security and resilience of low-input agriculture systems? * How can improved legume systems enhance the productivity and profitability of these farming systems? * What economic, social, and human benefits of CA systems can be expected in the short and long term? * What are the barriers to CA adoption? | | | | |
|  | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis  Final research in this activity will be conducted in already established on-farm long-term trials using previously developed protocols and datasheets. These trials have been running for 9 years in Zambia and up to 16 years in Malawi. Sixteen research clusters in on-farm target communities will be used to finalize outstanding research on CA systems in these research areas.  In brief, each research cluster in a target community consists of 6 replicated farmers’ fields with technology testing and socio-economic data taking. Within each farmers’ field, there are several technology components on trial which consist of no-tillage, residue retention, rotation, intercropping, drought-tolerant seed, doubled-up legume systems which are compared against the conventional control practices of tillage, residue removal, monocropping. The treatments and different management strategies are summarized in Table 1 below.  *Table 1:* Treatments tested in different target areas of southern Africa under Africa RISING   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Site cluster | Conventional system | CA option 1 | CA option 2 | CA option 3 | | Central Malawi | Ridge tillage, maize- legume rotation | Dibble stick, maize- doubled-up legume rotation | Dibble stick, maize/legume intercropping- legume rotation |  | | Trials were sequentially established from 2005 onwards. All maize is fully rotated with groundnuts since 2010 and since 2013, maize plots are sub-divided into 6 subplots testing 5 drought-tolerant maize varieties and a conventional control. Fertilizer level is 69 kg ha-1 N:21 kg ha-1 P2O5:0 kg ha-1 K20: 4 kg ha-1S | | | | | | Southern Malawi | Ridge tillage, maize- legume rotation | Dibble stick, maize- doubled-up legume rotation | Dibble stick, maize/legume intercropping—doubled-up legume rotation |  | | Trials were sequentially established from 2005 onwards. All maize is fully rotated with pigeon peas, cowpeas, or groundnuts since 2011 depending on sites and since 2013, maize plots are sub-divided into 6 subplots testing 5 drought-tolerant maize varieties and a conventional control; Fertilizer level is 69 kg ha-1 N:21 kg ha-1 P2O5:0 kg ha-1 K20: 4 kg ha-1S | | | | | | Eastern Zambia  (manual) | Ridge tillage, maize | Dibble stick, maize | Dibble stick, maize-legume intercropping | Dibble stick, maize- rotation | | Eastern Zambia  (animal traction) | Conventional moldboard plowing, maize | Ripline seeding/direct seeding, maize | Ripline seeding/direct seeding, maize- legume rotation |  | | Trials were established from 2011 onwards. All maize was planted as continuous sole crop, intercrop, or in full rotation; Fertilizer level is 108 kg ha-1 N:40 kg ha-1 P2O5: 20 kg ha-1 K20 | | | | |   The on-farm trials have been traditionally used to study productivity and environmental indicators but will be used in this final year for detailed studies of environmental indicators (soil carbon, infiltration); farmers’ perception of technologies and farmers’ choice; detailed studies on economic profitability; and for other studies on labor use and distribution amongst gender groups (see indicator matrix). Different sampling strategies measurement methods will be used to assess the socio-economic effects of CA ranging from targeted participatory rural appraisals (PRAs) and socio-economic surveys led by a consultant. | | | | |
|  | | | | |
| 5. Data (with indicators and metrics) to be collected and uploaded on Dataverse | | | | |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | SI Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | Responsible | | Productivity | | | | | |  | | Crop productivity | Yield (kg/ha/season); |  |  |  | Crop cuts and detailed yield measurement | CIMMYT with partners | | Crop biomass productivity | Residue production (kg/ha/season |  |  |  | Crop cuts and detailed yield measurement | CIMMYT with partners | | Economic | | | | | |  | | Profitability | Gross margin (USD/ha/season) |  |  |  | PRA | Consultant | | Returns to land, labor, input | Returns to investment |  |  |  | Survey | Consultant | | Labor requirement | Labor requirements |  |  |  | Survey | Consultant and Partners | | Labor requirement | Farming rating of labor |  |  |  | PRA | Consultant and Partners | | Environmental | | | | | |  | | Soil biology | Total Carbon (%) |  |  |  | Soil analysis of on-farm sites in laboratory | CIMMYT with partners | | Erosion | Rating of erosion | Rating of erosion |  |  | Farmer rating | CIMMYT | | Infiltration | Time to Pond measurement |  |  |  |  |  | | Social | | | | | |  | | Equity (generally) | Rating of technologies by gender |  |  |  | PRA |  | | Gender equity |  |  | women’s time and empowerment index |  | Survey | Consultant | | Human | | | | | |  | | Nutrition | Protein production (g/ha) |  |  |  | Survey | Consultant | | Nutrition |  |  | Dietary diversity score |  | Survey | Consultant | | Nutrition |  |  | Food consumption score |  | Survey | Consultant | | Food security |  |  | Month of food insecurity |  | Survey | Consultant | | Food security |  |  | Food security composite Index |  | Survey | Consultant | | Food security |  |  | Rating of Food security |  | Survey | Consultant | | | | | |
|  | | | | |
| 6. Deliverables: | | Means of verification | | Delivery date |
| 6.1 Trials designed and protocols updated | | Protocol available (no change) | | Oct. 2020 |
| 6.2 Trials established | | Technical report | | Mar. 2021 |
| 6.3 Monitoring | | Field tours, report | | Apr. 2021 |
| 6.4 Data generated and uploaded | | Annual Report, end of project report | | Sep. 2021 |
| 6.5 Knowledge products for smallholder farmers | | Technology briefs tailored to smallholder farmers | | Sep. 2021 |
| 6.6 Upload data into Dataverse | | Data uploaded | | Sep. 2021 |
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| 7. How will scaling be achieved? | | | | |

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| * Malawi and Zambian extension system at the district level (e.g., the District Agricultural Extension Coordinating Committees – DAECC in Malawi) is a prime vehicle for disseminating improved CA technologies to other EPAs and districts. Ministry of Agriculture Extension service will continue supporting CIMMYT in scaling activities. * CIMMYT will get evidence of all programs that currently promote CA scaling in the region and summarize these to better understand what scaling technologies work, what enablers are fruitful, and what regulatory fosters the out-scaling of these systems. |
|  |
| 8. How are activities in this protocol linked to those of others? |
| Data from CA on-farm trial are important in the Maize-Legume system assessment done by MSU and CIMMYT will collaborate intensely with this group. Collaboration will be sought with Francis Muthoni on targeting and Julius Manda on the endline survey. There is also scope of engaging with Gundula Fisher on gender-related questions. |

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| 9. Gantt chart | 2020 | | | 2021 | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Contracting and finalization of subgrants |  |  |  |  |  |  |  |  |  |  |  |  |
| Field implementation |  |  |  |  |  |  |  |  |  |  |  |  |
| Field visits and tours |  |  |  |  |  |  |  |  |  |  |  |  |
| Evaluation meetings |  |  |  |  |  |  |  |  |  |  |  |  |
| Harvest |  |  |  |  |  |  |  |  |  |  |  |  |
| Analysis and summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Report writing |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | | | |
| a. Output 5.1 | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | | | | | |
| b. Activity 5.1.1 | Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations | | | | | | | |
| c. Sub-Activity 5.1.1.2 | Explore the productivity domains of selected legumes and cereals to elucidate their best fitting cropping system at the community/landscape levels and their dissemination | | | | | | | |
|  |  | | | | | | | |
| d. Research team | | | | | | | | |
| Name | Institution | | Role | | | | | |
| Patrick Okori | ICRISAT | | PI, coordinate the assembly of data from both research and monitoring activities | | | | | |
| Julius Manda | IITA | | Backstop socio-economic analysis | | | | | |
| Jeroen Groot | WUR | | Support Trade-off analysis | | | | | |
| Daniel Mgalla | IITA | | Provide support in monitoring research activities to ensure compliance to FtF monitoring system, including periodically assisting in data collection (both FtF and custom indicators data) and uploading of data into the FtF data management system | | | | | |
| TARI technicians/ Extension officers | TARI-Naliendele, TARI-Hombolo, DAICO staff of Kiteto, Kongwa districts | | Backstop field days and other limited field monitoring activities as required | | | | | |
|  | | | | | | | | |
| e. Student(s) | | | | | | | | |
| Name | Institute | | Degree | | | Start | End | |
| New student to be recruited | Sokoine University of Agriculture | | MSc in Crop Science | | | November 2020 | July 2021 | |
|  | | | | | | | | |
| f. Location(s)  District, Village | Kongwa District, Villages-Chitego, Mlali, Laikala Moleti; Kiteto District- Villages-Njoro | | | | | | | |
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| g. Start date | November 2020 | | | | | | | |
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| h. End date | September 2021 | | | | | | | |
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| 1. Justification | | | | | | | | |
| Over the last five years, we have developed dryland legume and cereal crop varieties specifically adapted for semi-arid ecologies of central Tanzania. In the last two years, we evaluated and identified genotype-by-management fit of these materials in three sub-agro-ecologies. We found that three factors are critical for increased productivity i.e., (i) a shift to intercropping, (ii) early planting increases yield in legumes- short duration groundnut by 13%, over the medium duration groundnut and 91% over the landrace); medium-duration pigeon pea (13%)- and with long duration 33%) and; dryland cereals (133%-44%), for sorghum and pearl millet respectively, when planted early/on-time, in the right sub-agroecology. The differences in productivity between moderately and highly productive sub-agro-ecologies in the 2019-2020, cropping season, were generally minimal, although in many cases, under timely planting, productivity-differences were larger than in the low potential sub-agroecology. Even there, early planting was beneficial. Overall, we understand the ecology x genotype and management fit, with data assembled for SIAF indicators on productivity (grain yield t/ha) and economic benefits – (gross margins/ha). However, we need to assemble the critical set of SIAF indicators for human and social domains as marked (Figure 1). | | | | | | | | |
| Figure 1: Modified Africa RISING conceptual framework. The marked area is the focus of our proposed work for 2020-2021.  The information generated is important for informing scaling-out of the new productivity-enhancing technologies, because the adoption of new Agri-innovations, requires that they are not only more productive but should also contribute to other livelihood needs (food, nutrition, income, save labor, and other household needs). This work will be done by a combination of biophysical scientists (ICRISAT-led), supported by socioeconomics (Economics, Gender Specialist/Sociology)- Africa RISING. We will also seek backstopping on trade-off analysis by Wageningen University and Research (WUR) seconded scientist. Previously, the WUR scientist worked with the team and we will build on that process. These issues are well captured by some SIAF indicators, for which data was not collected which will be done in the period 2020-2021. | | | | | | | | |
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| 2. Objectives | | | | | | | | |
| 2.1 To evaluate the performance of proven legume-legume (groundnut and pigeon pea) and legume-cereal (sorghum and pearl millet and pigeon pea) intercrops for delivery of critical livelihood benefits to farming communities in stressed and moderately stressed sub-agro-ecologies of Kongwa and Kiteto | | | | | | | | |
|  | | | | | | | | |
| 3. Research questions | | | | | | | | |
| 3.1 How do the proven cropping systems and their associated technologies affect key livelihood domains of economic, social, and food and nutrition security needs of farming communities in these dryland agro-ecologies? | | | | | | | | |
|  | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | |
| Experiment design, implementation, and data analysis  These studies will be implemented at the plot and farm level, to collect data on production, economic, social, and human SIAF domains. While we have data at plot level for production and economic (only gross margin data) domains, the 2019-2020 cropping season was unique, the season having received above-normal precipitation. Moreover, we do not have the same data at the farm level, nor do we have human and social domain data, at all levels. Yet such data is crucial for making a meaningful assessment of the potential outcomes of Africa RISING agri-innovations. To collect this data at the farm level, the study will follow a randomized control trial design, in which the same population differs concerning access to or adoption of Africa RISING agri-innovations generated by the project activities. The study population is projected to be 150 households or more, comprising of an experimental/beneficiary household cohort and a counter-factual/non-beneficiary household cohort, the negative control. Beneficiary households are those hosting baby trials or are active members of community seed banks and seed producer associations created by Africa RISING. The counter-factual cohort comprises farm households that have not received any Africa RISING agri-innovations.  The study will be implemented in two contrasting production environments we identified before as they are the major agro-ecologies in these drylands. Proven legume-legume and legume-cereal production technologies will be established in contrasting environments and data will be collected on the focus SIAF domain indicators from the two study cohorts. Farm-level data will be validated using researcher-managed plots. This is essential given the high variability in weather in the semi-arid dryland agro-ecologies of central Tanzania. Plot level data from previous seasons will be used to study trends in gross margins of the technologies, the economic domain indicator we have used previously. Economic data at the farm level will be assembled through a survey, analyzed for variability, and subsequently used to compute the selected domain indicators. Economic domain data will be obtained from groups and individuals. Data for social domain indicators will be collected from community seed bank beneficiaries, groups, or associations, using participatory evaluation of technologies in gender-disaggregated groups. As appropriate, focus group discussions and or participatory exercises such as (matrix scoring) will be used. Both qualitative and quantitative data will be collected. To investigate how changes in cropping systems affect the farming system, spider-diagrams, and as appropriate, trade-off analysis will be performed, using SIAF indicator domain data. This will elucidate the impact of innovations on livelihood options as well as identify promising choices with the least penalty. | | | | | | | | |
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| 5. Data to be collected and uploaded on Dataverse | | | | | | | | |
| Domain & *Indicator* | | Field/plot level metrics | | Farm-level metrics | Household level metrics | Community /landscape metrics | | Measurement method |
| Productivity | | | | | | | | |
| *e.g. Crop (Pearl* millet, sorghum, pigeon pea and groundnut*) productivity* | | Yield (kg/ha/season) | | Yield (kg/ha/season) |  |  | | Yield measurement |
| *e.g. Crop (Pearl* millet, sorghum, pigeon pea, and groundnut*) biomass productivity* | | Residue production (kg/ha/season) | | Residue production (kg/ha/season) |  |  | | Yield measurement |
| Economic | | | | | | | | |
| Profitability | | Net income ($/crop/ha/season) | | Net income (Total net income for all farm activities) |  |  | | Participatory Evaluation |
| Labor requirement | | Labor requirement (hours/ha) | | Labor requirement (hours/ha) |  |  | | Direct observation/farmer evaluation |
| Human condition | | | | | | | | |
| Capacity to experiment | |  | |  | No. of new practices being tested |  | | Focus group discussion |
| Nutrition | |  | | Protein production (g/ha) |  |  | | Conversion using Lookup tables |
| Food security | |  | | Food production (calories/ha) |  |  | | Conversion using Lookup tables |
| Social | | | | | | | | |
| Equity | | Rating of technologies by group, Capacity to access information | | Rating of technologies by group, Capacity to access information |  | Participation in social groups | | Participatory Evaluation/key informant interview |
| Social cohesion | | Participation in community activities | | Participation in community activities | Participation in community activities |  | | Key informant interviews, Focus group discussions |

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| 6. Deliverables | Means of verification | Delivery date |
| 6.1 Field days for technology dissemination | Team project reports (technical Oct-Mar & April-Sept; submitted to Africa RISING indicative of the relative importance of the innovations on key livelihoods indicators as assessed by SIAF indicators  FtF data submitted to the M&E Officer for upload to USAID FtF Platform | Aug. 2021 |
| 6.2 Relative benefits and or trade-offs when the proven technologies are tested in contrasting sub-agro ecologies of central Tanzania. | Team project reports (technical Oct-Mar & April-Sept; submitted to Africa RISING indicative of the relative importance of the innovations on key livelihoods indicators as assessed by SIAF indicators  Research data collected, verified by upload on DataVerse  FtF data, submitted to the M&E Officer for upload to USAID FtF Platform  Draft manuscripts for publication (legume-legumes and legume-cereal) in a peer-reviewed journal (verified by Chief Scientist) | 30 Sep. 2021 |
| 6.3 Capacity for on-farm research by end-users strengthened. | Team project reports (technical Oct-Mar & April-Sept) submitted to Africa RISING indicating partners involved, number of farmers directly hosting trials  FtF data, submitted to the M&E Officer for upload to USAID FtF Platform | 30 Sep. 2021 |
| 6.4 Partnership for production o delivery of AR innovations operationalized | Team project report (technical Oct-Mar & April-Sept) submitted to Africa RISING indicating activities between Africa RISING and KFS and/or DASPA and Africa RISING research beneficiary communities  FtF data, submitted to the M&E Officer for upload to USAID FtF Platform | 30 Sep. 2021 |
| 6.5 Farmers and other beneficiaries made gain knowledge about new AR agri-innovations | Team project report (technical Oct-Mar & April-Sept) submitted to Africa RISING indicating field days and exposure events held  FtF data, submitted to the M&E Officer for upload to USAID FtF Platform | Aug. 2021 |
| 6.6 Environment mapping of the fit technologies to the production ecologies | Maps showing environmental mapping of the technologies in the semi-arid ecologies  Potential publication depending on the nature of data (Draft verified by Chief Scientist) | Sep. 2021 |
| 7. How will scaling be achieved? | | | |
| Partnerships  Building on the partnerships with TARI Institutes (Hombolo), the Local Governments (through the DAICO offices)- our long-term partners for research to delivery, as well as our new partnerships involving Kibaigwa Flour Supplies (KFS) and Dodoma Agricultural Seed Producers’ Association (DASPA), the team will leverage these partners and their networks to take technology to scale. It should be noted that this will be the first year for full implementation of the MOU between DASPA and KFS and ICRISAT. | | | |
| Knowledge dissemination  Through field days and promotional campaigns in all test sites to reach at least 2,000 farmer | | | |
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| 8. How are the activities in this protocol linked to those of others? | | | |
| * Multi-team participation will be used to leverage complementarities and to explore the synergies * GIS (IITA) team will be leveraged for the site and environmental mapping activities | | | |

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| 9. Gantt chart | 2020 | | 2021 | | | | | | | | | | | | |
| Activity/ month | Oct/Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec |
| Farmer mobilization |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Experiment establishment & management |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field monitoring |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection social & human domains |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection Economic domain |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data collection productivity & environment domains |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Field days & promotional event |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Data analysis and reporting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| Project Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | |
| a. Output 5.1: | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | | | |
| b. Activity 5.1.1: | Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations | | | | | |
| c. Sub-activity 5.1.1.4a: | Case studies: Application of SI technologies use among farmers interacting with Africa RISING at different intensities in 16 target communities | | | | | |
|  | | | | | | |
| d. Systems research team: | | | | | | |
| Name | Institution | Role | | | | |
| Christian Thierfelder | CIMMYT | PI, research conceptualization, design, oversight | | | | |
| Regis Chikowo | MSU | PI, research conceptualization, design, oversight | | | | |
| Consultant | IITA | Socio-economic research, oversight (level of effort: 30 consulting days) | | | | |
| Julius Manda | IITA | Econometric modeling | | | | |
| Mphatso Gama | Machinga ADD | Implementation and scaling | | | | |
|  | | | | | | |
| e. Student(s): | | | | | | |
| Name | Institute | Degree | | Start | | End |
| Isaac Mavico | University of Zimbabwe | MSc in plant science | | Nov. 2019 | | Sep. 21 |
| Tinashe Taringa | University of Zimbabwe | MSc in economics | | Nov. 2019 | | Sep. 21 |
|  | | | | | | |
| f. Location(s): | Lemu, Matandika, Songani in Malawi | | | | | |
|  | | | | | | |
| g. Start date | This is building on existing studies started in 2007 but detailed research will start in November 2020 | | | | | |
|  | | | | | | |
| h. End date | September 2021 | | | | | |
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| 1. Justification | | | | | | |
| Africa RISING project started interacting with farmers that have been using SI technologies since the 2005/2006 cropping season in three agro-ecologies in central Malawi. Over time, some new farmers were engaged, creating an opportunity to also study exposure time as a factor to understand the intensity and use of SI technologies:   * Mother trial farmers – these are farmers who hosted fully replicated trials with a range of technologies, often more than 8 treatments. They are a nucleus group of farmers, who anchor the learning process. They are more visited by researchers and often host field days. Farmer interaction with researchers and extension is rated as ‘high’. Three mother trials per agroecology will be selected. * Mother trial farmer experimenter – these are the same host farmers who are applying SI technologies on their wider farm. * Baby farmers: These are a selected group of farmers who are associated with a mother trial. These farmers usually participate in field days and engage extension staff. * Different local controls: These farmers are located in the same village as the mother and baby trial farmers. They do not directly benefit from Africa RISING but are exposed to Africa RISING technologies through field days. They often do not directly relate to the project.   The mother trials are often planted on time, with the best agronomic practices (fertilizer management, appropriate rotations, soybean inoculation with good bacteria strain, weeding, etc.). We hypothesize that crop productivity on mother trials typically represents water-limited yield potential for the different agro-ecologies. These crop yields will be used as benchmarks to assess the level of intensification at the farm scale for the three farmers’ groups (II, III, and IV).  This activity will profile the technologies of farmers and assess the impact at farm scale. We hypothesize that mother trial farmers are more likely to adopt more technologies as they more closely interact with a range of SI technologies on the mother trials. We will investigate whether these farmers with more SI technologies are also more resilient to shocks.  *While many activities were done during the 2019/2020 cropping season*, there are some outstanding surveys, *especially on the social and human domains* which could not be finalized during last year due to COVID-19. We, therefore, propose to complete these activities to bring them to a fruitful end. We will resume survey activities the moment that travels will be possible again. This will be essential to have strong case studies for the End of Project Report. No additional budget is requested for this activity except some staff time as it will be paid from unused funds. | | | | | | |
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| 2. Objectives | | | | | | |
| The objective of the case studies is to better understand yield differences and socio-economic benefits at farm level across different farm types and assess their impact on farmers’ livelihood. | | | | | | |
|  | | | | | | |
| 3. Research questions | | | | | | |
| 3. 1 What are the effects of SI technologies on productivity, profitability, economic, social, and human benefits for different types of farmers in the Africa RISING project? | | | | | | |
| 3.2 How effective is the diffusion strategy through mother and baby trials in technology transfer? | | | | | | |
|  | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | |
| 4. Experiment design:   * Mother trial – representing the water-limited yields * Mother trial farmer’s with own field * Baby trial farmer’s NP fertilized field * Control farmer’s NP fertilized field   This research will primarily be done through joint implementation of different types of measurements led by students supervised through MSU and CIMMYT. Socio-economic data collection led by CIMMYT will be primarily be done through PRAs and Surveys. | | | | | | |
|  | | | | | | |
| 5. Data (with indicators and metrics) to be collected and uploaded on Dataverse (activity not completed last year due to COVID). | | | | | | |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | SI Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | Responsible | | Productivity | | | | | | | | Crop productivity | Yield (kg/ha/season) |  |  |  | Crop cuts and detailed yield measurement | CIMMYT with partners | | Crop biomass productivity | Residue production (kg/ha/season |  |  |  | Crop cuts and detailed yield measurement | CIMMYT with partners | | Economic | | | | | | | | Profitability | Gross margin (USD/ha/season) |  |  |  | PRA | Consultant | | Returns to land, labor, input | Returns to investment |  |  |  | Survey | Consultant | | Labor requirement | Labor requirements |  |  |  | Survey | Consultant and Partners | | Labor requirement | Farming rating of labor |  |  |  | PRA | Consultant and Partners | | Environment | | | | | | | | Soil biology | Total Carbon (%) |  |  |  | Soil analysis of on-farm sites in laboratory | CIMMYT with partners | | Erosion | Rating of erosion | Rating of erosion |  |  | Farmer rating | CIMMYT | | Infiltration | Time to Pond measurement |  |  |  |  |  | | Social | | | | | | | | Equity (generally) | Rating of technologies by gender |  |  |  | PRA |  | | Gender equity |  |  | women’s time and empowerment index |  | Survey | Consultant | | Human | | | | | | | | Nutrition | Protein production (g/ha) |  |  |  | Survey | Consultant | | Nutrition |  |  | Dietary diversity score |  | Survey | Consultant | | Nutrition |  |  | Food consumption score |  | Survey | Consultant | | Food security |  |  | Month of food insecurity |  | Survey | Consultant | | Food security |  |  | Food security composite Index |  | Survey | Consultant | | Food security |  |  | Rating of Food security |  | Survey | Consultant | | | | | | | |
| Note: most of the biophysical domain indicators have already been captured but additional surveys are required to finalize economic, human, and social indicators. This activity is therefore not considered completed and the indicators are repeated for completeness. The remaining studies will be conducted as soon as COVID restrictions are lifted. | | | | | | |
| 6. Deliverables: | | | Means of verification | | Delivery date | |
| Survey instrument verified | | | Protocol available | | Dec. 2020 | |
| Surveys conducted | | | Technical report | | Mar. 2021 | |
| Monitoring by students | | | Field tours, report | | Jul. 2021 | |
| Econometric model set up | | | Report | | Mar. 2021 | |
| Model Results after validation | | | Report | | Aug. 2021 | |
| Data generated and uploaded into Dataverse | | | Data and Report | | Sep. 2021 | |

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| 7. How will scaling be achieved? |
| Scaling is not intended directly from this study but will be indirectly achieved after the results are being published |
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| 8. How are the activities in this protocol linked to those of others? |
| This is a direct collaboration between MSU and CIMMYT |

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| 9. Gantt chart | 2020 | 2021 | | | | | | | |
| Activity/ month | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug |
| Re-establishing of farmer connection |  |  |  |  |  |  |  |  |  |
| PRAs and Focus Group discussions |  |  |  |  |  |  |  |  |  |
| Surveys |  |  |  |  |  |  |  |  |  |
| Analysis |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | |
| a. Output 5.1 | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | | | |
| b. Activity 5.1.1 | Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations | | | | | |
| c. Sub-activity 5.1.1.4b | Case studies: Application of SI technologies use among farmers interacting with Africa RISING at different intensities | | | | | |
|  | | | | | | |
| d. Research team | | | | | | |
| Name | Institution | Role | | | | |
| Sieg Snapp/Regis Chikowo | MSU | Research design, supervision of fieldwork, MSc student; Modules 1 and 2 | | | | |
| Wezi Mhango | LUANAR | Fieldwork, MSc student, Module 1 and 2 | | | | |
| Christian Thierfelder | CIMMYT | Conservation agriculture integration, southern Malawi sites | | | | |
| Munyaradzi Mutenje | IITA Consultant | Socio-economics analyses (Module 3) | | | | |
| Julius Manda | IITA | Socio-economics analyses (Module 3) | | | | |
|  | | | | | | |
| e. Student(s) | | | | | | |
| Name | Institute | Degree | | Start | End | |
| Tinashe Taringa and Isaac Maviko | LUANAR and University of Zimbabwe | MSc | | October 2019 | Dec. 2021 | |
|  | | | | | | |
| f. Location(s) | Golomoti, Kandeu, Linthipe (MSU led long-term experiments in these EPAs);  Lemu, Matandika, Songani (CIMMYT led long-term experiments in these EPAs) | | | | | |
|  | | | | | | |
| g. Start date | October 2019 | | | | | |
|  | | | | | | |
| h. End date | September 2021 | | | | | |
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| 1. Justification | | | | | | |
| Africa RISING project started interacting with farmers during the 2012/13 cropping season in three agro-ecologies in central Malawi. CIMMYT started interacting with farmers that have been using CA-based SI technologies since the 2007/2008 cropping season in three agro-ecologies in central Malawi. Mother trials that are at least 5 years from both MSU and CIMMYT-led activities will be selected for this study.  This study was initiated during the 2019/20 cropping season, with three mother trials, three baby trials, and three control farmers in Linthipe, Kandeu, Golomoti, Zomba, and Balaka. Lessons from Year 1 (2019/20) suggest that this design was inadequate as there was little power in the sample size. The number of mother trials is arguably limited, but this is adequately catered for by in-field replication. We can therefore have confidence in the results. However, only three farms for baby and control trials were inadequate as high variability in-field soil fertility in farmers’ fields and farmer heterogeneity could mean a gross misrepresentation of the farms through a small sample size. Also, we could not, with confidence, quantify the intensity of local diffusion as the local controls are co-located in the villages with mother and baby farmers. The proposed new design has an extra ‘treatment’, the distant control farmers, as follows:   1. Mother trial farmers – at least 4 mother trials per agroecology, drawn from the long-term trials that are maintained in sub-activity 1.1.1.2 (Investigations on the medium to long term impacts of SI technologies (improved soil fertility management, improved germplasm, crop combinations, nutrient and water management) on crop productivity on multi-locational field sites 2. Mother trial host farms – farm-scale analysis of all the mother trial host farmers from sub-activity 1.1.1.2. At least three yield–cut replications for each of the fields and for each of the crops established on the farm, irrespective of whether the crops are part of the mother trials (this would inform productivity and crop diversity on the farms) 3. Baby farmers: Farm scale analysis of at least 8 baby trial host farmers for each of the sites. 4. Local controls: Farm scale analysis of at least 8 local control farmers randomly selected from 100s of farmers in the community with no record of directly engaging with Africa RISING, and 5. Distant controls: Farm scale analysis of at least 8 distant control farmers randomly selected from 100s of farmers in another distant community (at least 10 km), with similar agroecological conditions. These local controls should ideally be in neighboring EPA with a different set of extension workers, to minimize any chances of contamination. The difference between IV and V will improve the overall interpretation of the results.   Mother trials are often planted on time, with the best agronomic practices (fertilizer management, appropriate rotations, soybean inoculation with good bacteria strain, weeding, etc.). We hypothesize that crop productivity on mother trials typically represents water-limited yield potential for the different agro-ecologies. These crop yields will be used as benchmarks to assess the level of intensification at farm-scale for the four farmers’ groups (II, III IV and V) (Figure 1).  a  b  c  d | | | | | | |
| Figure 1. Conceptual framework for assessing the impact of Africa RISING interventions through yield gap analysis and production, for farmers interacting with Africa RISING at different intensities. Yield gap ‘a’ illustrates the difference between optimized use of NP (water-limited yield) and knowledgeable farmer adapted SI, ‘b’ is a function of knowledge intensity gap between mother and baby trial farmers, and ‘c’ is the yield that non-participating local farmers forfeit, and ‘d’ is the exploitable intensification gap. The y-axis variable is here given as maize but could be any other crop. This analysis is true for farmers in similar resource endowment groups. A distant control has been included to better inform the level of local diffusion | | | | | | |
| This activity will profile technologies of farmers and assess the impact at farm scale. We hypothesize that mother trial farmers are more likely to adopt more technologies as they more closely interact with a range of SI technologies on the mother trials. We will investigate whether these farmers with more SI technologies are also more resilient to shocks. Through this sub-activity, we will be able to give feedback on SI technologies and their use firmly anchored on empirical evidence from the detailed whole farm systems analysis. This would feed into policy discussions. | | | | | | |
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| 2. Objectives | | | | | | |
| 2.1 To determine differentials in farm-scale uptake off SI technologies for mother trial host farmers, baby trial farmers, and farmers not directly participating in Africa RISING activities  2.2 To determine the effect of farm typology of adoption of SI technologies | | | | | | |
|  | | | | | | |
| 3. Research questions  This activity will profile the technologies of farmers and assess the impact at farm scale. | | | | | | |
| 3.1 Are mother trial farmers more likely to adopt more technologies as they more closely interact with a range of SI technologies on the mother trials? | | | | | | |
| 3.2 Are the farmers implementing a range of SI technologies also more resilient to shocks and have a larger SI index? | | | | | | |
|  | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | |
| Experiment design, implementation, and data analysis: See research protocol  Crop productivity on mother trials typically represents water-limited yield potential within each of the three agro-ecologies where the study will be carried out (high, medium, and low agroecological potential).  A total of 28 farms in each of the 3 EPAs in central Malawi (Linthipe, Kandue, and Golomoti) and two sites in southern Malawi (Balaka and Zomba) will be selected, to include 4 mother trial host farmers, 8 baby trial farmers, 8 non-participating local farmers, and 8 distant controls. The study is structured around three modules that will be implemented at different times of the cropping calendar. Here, we describe Modules 1 and 2 only. Module 3 on socioeconomics will be implemented by the IITA consultant, also across all sites  *Module 1:* 28 farms in each of the 5 EPAs will be characterized in detail from mid-January through February when the crops will be well established. Eight farms will be selected randomly from lists of baby farmers, local or distant controls. By mid-January when the field study will commence, all farmers would have completed crop establishment, therefore, the researchers will not influence farmer behavior in any way beyond the usual interaction with them as mother trial host farmers, baby farmers, or farmers who have not directly interacted with Africa RISING (the control farmers). Data will be collected on household composition, farm size, and individual fields and cropping for each field. Field sizes will be accurately determined through GPS area determination function. The range of crops established per farm will be recorded which will later be used to establish any association between ‘treatment’ and crop diversity index.  *Module 2:* This will be implemented during the March-May harvest period. The module is primarily on the determination of crop productivity through yields cuts on at least three replicates within each of the fields on a farm or trials.   * + - * Mother trials: crop yields will be determined on the mother trials, as has been done over the years since trials were implemented. The mother trials are optimally established. The yields from these trials are a good estimate of the potential for the different technologies in different environments. This yield level is ecologically referred to as water-limited yield potential.       * Mother trial farmers’ own farm: crop yields will be determined for each field on at least three positions in the field to capture within-field variability       * Baby trial farmer’s whole farm SI application: Within each EPA, 8 baby trial farmers will be randomly selected and crop yields determined for each of their fields.       * Eight local control farmers: Within each EPA, 8 local control farmers will be randomly selected and crop yields determined for each of their fields.       * Eight distant controls: Distant controls have to be at least 10 km from the intervention site, but with similar agroecology to control for climate-induced variations. Crops yields will be determined as described for other treatments   In all cases, plant density will be determined, and a soil sample taken to relate crop productivity and soil chemical and physical characteristics. For example, where NP fertilized maize is one of the SI technologies on the mother trial, maize yields on NP fertilized maize will be obtained from the other treatments (farmer categories).  Data collection and statistical analysis:   * Whole farm profiling soon after crops are established (mid-January onwards, Module 1) * The primary data to be collected will be grain yield and biomass productivity, and crop diversity (Module 2) * For mother trials, we will harvest the entire 3 middle rows, resulting in net plots of 5m x3 rows x0,75 m row spacing = 11.25 M2. * Harvests in farmers’ fields will be on at least three net plots along the diagonal of each field. Each net plot will comprise 2 rows x 3 m x row spacing. We expect net plots to be variable as farmers use different row spacing. Yields will be reported per hectare basis. * All fields will be geo-referenced and field sizes estimated by a GPS * The protein and calorie production from the various technologies will be used to inform the utility of the technologies regarding the human condition domain * To determine the effect of different SI technologies on soil organic carbon, soil samples will be collected for the 0-15 cm and analyzed for SOC using conventional laboratory methods * Where legumes are grown, the N- difference method will be used to estimate biological N2-fixation * Data from Module 1 (field sizes) will be matched with data from Module 1 (crop yields) to estimate total farm production for each of the crops. * Profitability will be assessed based on variable costs of inputs (fertilizers, seeds, labor) and the value of the produce (Module 3) * Module 3 will be implemented during the post-harvest period | | | | | | |
| 5. Data (with metrics) to be collected during the post-harvest period   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method | Responsible | | Productivity | | | | | |  | | Grain productivity | Maize and legume grain yield (kg/ha/season); | total farm production (kg/ha/farm) |  |  | Yield measurements | MSU | | Biomass productivity | Maize and legume grain and biomass yield (kg/ha/season |  |  |  | Yield measurements | MSU | | Yield gap | Yield gap for maize, and grain legumes (kg/ha/season) |  |  |  | Yield measurements | MSU | | Economic | | | | | |  | | Profitability | Net income ($/crop/ha/season)  Gross margin |  |  |  | Survey | IITA/MSU | | Environmental | | | | | |  | | Soil biology | Soil organic carbon (g/kg) |  |  |  | Laboratory analysis | MSU | | Soil chemical quality | Biological N2-fixation (kg/ha) | Biological N2-fixation(kg/farm) |  |  | Direct measurement | MSU | | Human condition | | | | | | MSU | | Nutrition | Protein production (g/ha); |  |  |  | Lookup tables | MSU | | Food security | Food production  (calories/ha/year) |  | Months of food insecurity |  | Lookup tables, survey | MSU | | Social | | | | | |  | | Gender equity | Rating of technologies by gender |  |  |  | Participatory evaluation | MSU | | Social cohesion |  |  | Participation in community activities |  | Focus group discussions |  | | | | | | | |
|  | | | | | | |
| 6. Deliverables | | | Means of verification | | | Delivery date |
| 6.1 Revised protocol finalized | | | Data collection protocol available | | | Nov. 2020 |
| 6.2 Detailed farm profiles documented | | | Data collected from Module 1 | | | Feb. 2021 |
| 6.3 Estimates of yield gaps; farm scale SI scaling | | | Excel files, raw field data (Module 2) | | | May 2021 |
| 6.4 Data combined and uploaded on DataVerse | | | Data files, reports | | | Sep. 2021 |
| 6.5 Socioeconomic indicators | | | Data collected from Module 3 –excel files, summary data | | | Sep. 2021 |
| 6.6 Scientific publication in an appropriate agricultural systems journal | | | Submitted manuscript (Draft verified by Chief Scientist) | | | Dec. 2021 |
|  | | | | | | |
| 7. How will scaling be achieved? | | | | | | |
| Scientific publication in an appropriate agricultural systems journal for wider dissemination to the scientific community | | | | | | |
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| 8. How are the activities in this protocol linked to those of others? | | | | | | |
| Mother and baby trials will be chosen from work implemented by MSU and CIMMYT | | | | | | |

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| 9. Gantt chart | 2020 | | 2021 | | | | | | | | | |
| Activity/ month | Nov. | Dec. | Jan. | Feb. -Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. |  |
| IITA –MSU contract/inputs distribution |  |  |  |  |  |  |  |  |  |  |  |
| MSU/partners contracting |  |  |  |  |  |  |  |  |  |  |  |
| Farmer/farms profiling for case studies (Module 1) |  |  |  |  |  |  |  |  |  |  |  |
| Yield data collection on cases study farms/harvesting Module 2) |  |  |  |  |  |  |  |  |  |  |  |
| Report writing/publications |  |  |  |  |  |  |  |  |  |  |  |
| DataVerse data upload |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | | | | |
| a. Output 5.1 | | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | | | | | |
| b. Activity 5.1.1 | | Farmer participatory experimentation with crop and soil management and integrated crop-livestock technologies in on-farm situations | | | | | | | |
| c. Sub-activity 5.1.1.5 | | Panel survey, soils processing and meta-analysis studies for maize-grain legumes sequences and implications for sustainability | | | | | | | |
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| d. Research team | | | | | | | | | |
| Name | | Institution | | | Role | | | | |
| Regis Chikowo | | MSU | | | Study conceptualization, data collation, data analysis, and synthesis | | | | |
| Sieg Snapp | | MSU | | | Study conceptualization, data analysis, and synthesis | | | | |
| Postdoctoral fellow | | MSU | | | Data analysis, and synthesis | | | | |
| Xinyi – lab technician | | MSU | | | Soil analysis (total SOC, POXC, available phosphorus) | | | | |
| Julius Manda | | IITA | | | Panel survey data analysis and synthesis | | | | |
|  | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | |
|  | | | | | | | | | |
| f. Location(s) | | Data from all sites in Malawi | | | | | | | |
|  | | | | | | | | | |
| g. Start date | | November 2013 | | | | | | | |
|  | | | | | | | | | |
| h. End date | | December 2021 | | | | | | | |
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| 1. Justification | | | | | | | | | |
| Panel study and synthesis  Malawi Africa RISING has implemented surveys, tracking 600 farmers during 2013 (baseline), 2014, and thereafter, each year. Another survey is planned for 2021. This is becoming an invaluable source of repeated observations derived by following a sample of households over time and by collecting data from a sequence of interviews. This panel survey is critical for collecting farmer opinions and practices, information that is potentially useful for better targeting of technologies and more informed decision making. For example, farmers have been trained on the appropriate use of nutrient resources, ecologically sound crop sequencing, and water management, among other technologies. During each of these surveys, we follow each of the farmers who have been tagged with unique household IDs. More importantly, we estimate crop productivity for two field types for each of the farms: the rich and poor fields as perceived by each of the panel farmers. Enumerators perform yields cuts on three net plot areas within each of the fields. It is important to be able to obtain a measure of progress being made by farmers. Often, the obvious variable of choice is crop productivity. However, soil organic carbon, a slow-changing attribute of soil, is regarded as one of the most important indices for soil health and sustainability. As we close out the project, we, therefore, plan to take stock of SOC content in farmer’s fields and compare the current status to baseline conditions, 8 years ago. To be able to compute SOC stocks, bulk density measurements are required. Bulk density will be measured using cylindrical cores for the 5-15 cm depth. Soil organic carbon stocks will be estimated for panel farms using the mass balance approach as modified by Hobley *et al*. (2018[[26]](#footnote-26)):  Cstock =Ccontent, fine ×1˗ mass proportioncourse × ρ ×d  where C*stock* is the amount of carbon stored in a given soil area (kg m−2) and depth, *d* (cm); mass proportion*coarse* is the mass proportion of the coarse soil to the whole soil sample (g kg−1) and ρ is the bulk density of the whole soil (g cm−3); and Ccontent,fine is the mass proportion of C in the fine soil fraction (g kg-1).  The soils will be analyzed for available P, and link cropping regimes and management to phosphorus availability. Several legumes plants, including pigeonpea, are known to mobilize soil phosphorus. | | | | | | | | | |
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| 2. Objectives | | | | | | | | | |
| 2.1 To complete the panel study based on farmers baselined during 2013 and 2016 | | | | | | | | | |
| 2.2 To conduct a meta-analysis on data from mother trials implemented over multi-locations and years | | | | | | | | | |
|  | | | | | | | | | |
| 3. Research questions | | | | | | | | | |
| Meta-analysis study: Several research questions will now be answered based on a large data set from more than 40 mother trials that were established in Malawi for over 8 years. Key questions to investigate for the meta-analysis include: | | | | | | | | | |
| 3.1 How does mother trial data inform better targeting of legume diversification? In particular, legume crops have been promoted for poorer and vulnerable populations – but are benefits consistent in marginal environments? | | | | | | | | | |
| 3.2 Which SI system is nutritionally superior to other systems in terms of protein produced and calories across agro-ecologies? | | | | | | | | | |
| 3.3 What is the magnitude of stability enhancement in cropping systems that integrate water management practices? | | | | | | | | | |
|  | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | |
| Experiment design, implementation, and data analysis  This work is based on data collected over the years from experiments described in sub-activity 1.1.1.2, as well as data from past panel surveys. There is now a rich library of soils that needs to be processed with a dedicated budget.   1. Data collection and statistical analysis  * A detailed survey instrument has been refined over the years and is ready for use * Each of the households is characterized, especially on variables that could affect overall farm efficiency, e.g., stability of labor availability, land ownership, over the years * Yield cuts will be carried on low and high fertility fields, and yields estimated * Soil samples will be collected on low and high fertility fields and analyzed for SOC content, as well the permanganate oxidizable carbon (POXC) that tends to reflect the labile soil C content. POXC is known is have greater sensitivity to management changes.   2) Meta-analysis of data from mother trials: Africa RISING has a large data set from 8 years of experimental work over more than 50 field sites. A meta-analysis publication is envisaged. | | | | | | | | | |
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| 5. Data (with metrics) to be collected and uploaded on DataVerse | | | | | | | | | |
| SI Domains & *Indicator* | Field/Plot level metrics | | Farm level metrics | | Household level metrics | Community/landscape metrics | Measurement method | | Responsible |
| Productivity | | | | | | | | | |
| Maize grain productivity | Maize grain yield (kg/ha/season); | | Maize production (kg/ha | |  |  | Yield measurements | | MSU |
| Legume grain productivity | Legume grain yield (kg/ha/season | | Legume production (kg/ha/season) | |  |  | Yield measurements | | MSU |
| Human condition | | | | | | | | | |
| Nutrition | Protein production (g/ha) | | Protein production (g/ha) | | Availability of diverse food crops; Dietary diversity; | Availability of diverse food crops; | Surveys  Laboratory testing | | MSU |
| Food Security |  | |  | | Food availability,  Food utilization  composite index |  | Surveys | | MSU |
| Economics | | | | | | | | | |
| Profitability | Net income ($/crop/ha/season); | |  | |  |  | survey | | IITA |
| Income diversification |  | |  | | Number of income sources |  | survey | | IITA |
| Social | | | | | | | | | |
| Gender Equity |  | |  | | Nutrition/Food security by gender | Women Empowerment in Agriculture Index | Individual survey; household survey | | MSU |
| Environmental | | | | | | | | | |
| Soil biology | SOC content (g/kg) | | SOC content (g/kg) | |  |  | laboratory | | MSU |
| Soil chemical quality | Biological N2-fixation | |  | |  |  |  | | MSU |
|  | | | | | | | | | |
| 6. Deliverables | | | | Means of verification | | | | Delivery date | |
| 6.1 Updated panel survey instrument | | | | Instrument available | | | | Mar. 2021 | |
| 6.2 Panel survey implemented | | | | E-files available | | | | Apr. -May 2021 | |
| 6.3 Meta-analysis data collated | | | | Manuscript draft available (verified by Chief Scientist) | | | | Jul. 2021 | |
| 6.4 Soil analysis | | | | SOC stocks available, bulk density, available P | | | | Dec. 2021 | |

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| 9. Gantt chart | 2020 | | 2021 | | | | | | | | |
| Activity/ month | Nov. | Dec. | Jan. | Feb. -Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. |
| IITA –MSU contract/inputs distribution |  |  |  |  |  |  |  |  |  |  |
| Meta-data compilation/analysis |  |  |  |  |  |  |  |  |  |  |
| Panel survey/soil sampling/lab soil analysis |  |  |  |  |  |  |  |  |  |  |
| Report writing/publications |  |  |  |  |  |  |  |  |  |  |
| DataVerse data upload |  |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | |
| a. Output | | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | |
| b. Activity 5.1.2 | | Use farm trial data to apply crop simulation models and assess performance over space and time, including assessment of climate-smart technologies to establish the potential for adaptation and mitigation | | |
| c. Sub-Activity 5.1.2.1 | | Apply the APSIM crop simulation model to assess changes in resource use efficiencies, productivity, and profitability of the different cropping systems in Kongwa, Kiteto and Iringa in Tanzania | | |
|  | | | | |
| d. Research team | | | | |
| Name | | Institution | Role | |
| Patrick Okori | | ICRISAT | PI | |
| Anthony Whitbread | | ICRISAT | Coordinate modeling work with ICRAF and within ICRISAT for data sets for cross country data sets, support drafting of papers generated from the studies | |
| Sieglinde Snapp | | MSU | Coordinate modeling work involving the Malawi activities and support drafting of papers generated from the studies | |
| Amos Ngwira | | ICRISAT | Complete the APSIM modeling work based on regional data sets (Malawi and Tanzania), engage with other Africa RISING agronomists for cross-site studies to draft papers | |
| Anthony Kimaro | | ICRAF | Engage with ICRISAT and MSU in modeling work on agroforestry | |
| Daniel Mgalla | | IITA | M&E support | |
|  | | | | |
| e. Student(s): Nil | | | | |
|  | |  | | |
| f. Location(s)  District, Village | | Kongwa District, Villages-Chitego, Mlali, Laikala, and Moleti; Kiteto District- Villages-Njoro or Kiperesa | | |
|  | | | | |
| g. Start date | | November 2018 | | |
|  | | | | |
| h. End date | | September 2021 | | |
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| 1. Justification | | | | |
| Simulations conducted in the Agricultural Production Systems Simulator (APSIM) from 2011-2019 rainfall and agronomic data from on-farm trials, and parameterized in APSIM, show for these semi-arid ecologies, precipitation is a big driver of crop performance. During this period, we will complete two main studies all based on APSIM modeling. First, using the data already available for Tanzania and Malawi for modeling conducted regional perspective as we complete the delivery of the remaining research products. Already, the Malawi data is analyzed and what remains is the completion of modeling using Tanzania data. Once completed, these studies will inform technology deployment for de-risking smallholder production in dryland ecologies such as central Tanzania and Malawi.  Additionally, from the on-station and on-farm experiments (activities of **5.1.1.2**), we will assemble second and third season data for the cereal legume intercrop systems involving pigeon pea and sorghum (third season) and or maize (second season). This data includes yield grain and biomass, as well as crop phenology. Data already assembled such as soil-water characteristics, bulk density, and % soil organic matter will be used, along with data obtained from NASA power on temperature and solar radiation of each study site. All data will be handled as previously described (2019-2020 ICRISAT- SUA workplan and budget). The key results informing the proposed work are:   1. Yield losses in pigeon pea-sorghum intercropping are 33% for sorghum under intercrop and up to 74% for pigeon pea. In both cases, intercropping compensates for the yield, albeit with lower land equivalent ratios compared to high potential sub-ecologies in these drylands ecologies. For every constrained environment such as Laikala, while intercropping is useful as is commonly practiced by farmers, the benefits are tapered by annual precipitation. Earlier, we reported that simulated grain yield for cereals (sorghum and pearl millet) and legumes (pigeon pea and groundnut), approximated observed yields, indicative of APSIM’s ability to predict cereal responses to intercropping. Completing the modeling assignment will generate information on the implications of sustainable intensification options on climate and market risks and resource use efficiency by smallholder agriculture, especially in drylands. 2. Across study sub-agro-ecologies for legume-legume systems, crop phenology plays a major role, especially the fit to specific cropping systems. For example, the medium duration (groundnut) and long duration (pigeon pea), are suitable only for high potential sub-agro-ecologies. In the cereal-legume system established in low potential sub-agro-ecologies, e.g., Igula, Iringa, and Laikala, pigeonpea grain yields reduced by up to 35%, especially when sorghum is intercropped with long duration pigeonpea, again suggesting an effect of varietal phenology. The modeling work when completed will inform the optimization of production and resource management in these constrained environments cereal-based systems. 3. Resource use efficiency will also be further clarified from the modeling. For example, in pigeon pea and groundnut doubled-up cropping system, simulated results show that the faster-establishing groundnut uses-up relatively larger quantities of available water resources especially under drought, before the slow-establishing pigeon pea, resulting in reduced pigeon pea yields, especially in long-duration material. Thus, productivity can inadvertently be affected by crop and variety compatibility. 4. Total soil organic C simulated in the top 15 cm of soil increased throughout our study (1980-2019) especially when pigeon pea was added to the cropping system signifying the importance of grain legumes in sequestering soil C and eventual sustainability of the cropping systems. Further experimentation and validation of these finding is needed to inform the utilization of appropriate management systems for intercrops that enhance productivity and farming household resilience. | | | | |
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| 2. Objectives | | | | |
| 2.1 To complete APSIM modeling of doubled-up legume at regional level (Malawi + Tanzania) enabling prediction of yields of improved groundnut and pigeon pea under varied agro-ecologies through on-farm experimentation | | | | |
| 2.2 To complete the APSIM modeling of Cereal-legume intercropping systems at the regional level (Malawi + Tanzania) enabling yield prediction of improved and resilient cereals (Sorghum) and legumes-pigeon pea under varied agro-ecologies through on-farm experimentation | | | | |
| 2.3 To assess the long-term implications of sustainable intensification options on climate and market risks and resource use efficiency of smallholder farms in central Tanzania and Malawi | | | | |
| 2.4 Identify and propose proven climate-resilient practices that will be used to improve the resilience of legume-legume and cereal and legume cropping systems to climate change while minimizing climate risks and stabilizing productivity | | | | |
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| 3. Research questions | | | | |
| 3.1 To what extent does APSIM model predict the performance of doubled-up legume and cereal-legume intercrop systems under stressed and moderately stressed environments of central Tanzania? | | | | |
| 3.2 To what extent does the use of improved drought-tolerant and nutrient-dense varieties in semi-arid environments influence water and nutrient use efficiencies of farming systems? | | | | |
| 3.3 What is the long-term implication of using improved drought-tolerant varieties in minimizing climate and market risks in the face of increased weather variability? | | | | |
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| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis  In Tanzania, experiments will be established in three sub-agro-ecologies (same as for 5.1.1.2), using the mother-baby trial approach. The mother trials are research control sites where optimal agronomy is ensured. The babies are farmer-managed trials, the genetics controlled by giving farmers the same varieties, but whose management may vary. This way, we will be able to capture data across a broad spectrum of production conditions in the semi-arid ecologies of central Tanzania. It should be noted that the majority of baby-trial hosts are members of community seed banks, trained on good agronomy.  In Malawi, a similar set up of the mother-baby trial approach will be used to establish experiments in two sub ecologies i.e., lowland agroecology i.e., (200-500 meters above sea level, usually in the dryland system) that receives less than 600 mm of rainfall annually; and the mid-altitude agroecology (501-1300 meters above sea level), that receives less than < 800 mm of rainfall annually. The low land agroecology is similar to the constrained sub-agroecology of Kongwa and Kiteto, while the mid-altitude is similar to the high potential sub-agroecology.  Using this arrangement, the research team will create scenarios to assess the efficacy of sustainable intensification options on climate and market risks as well as resource use efficiency of smallholder agriculture. These scenarios include: Grouping cropping systems into climate variability, agro-ecological zones, soils, and management practices. The calibrated model for the legume-legume (already done in Malawi and partially for Tanzania data respectively) will be used. Long-term simulations using long-term climatic data obtained from NASA will be used for the simulations. This effort will lead to the assessment of changes in the resource base, resource use efficiencies, productivity, and profitability of the different cropping systems in central Tanzania. | | | | |
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| 5. Data to be collected and uploaded on DataVerse | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | | Productivity | | | | | | | *e.g. Crop (Pearl* millet, sorghum, pigeon pea and groundnut*) productivity* | Yield (kg/ha/season) | Yield (kg/ha/season) |  |  | Yield measurement | | *e.g. Crop (Pearl* millet, sorghum, pigeon pea, and groundnut*) biomass productivity* | Residue production (kg/ha/season) | Residue production (kg/ha/season) |  |  | Yield measurement | | Variability of production | Coefficient of variability  Probability of low productivity | Coefficient of variability  Probability of low productivity |  |  | Productivity over time | | Economic | | | | | | | Profitability | Net income ($/crop/ha/season) | Net income (Total net income for all farm activities) |  |  | Participatory Evaluation | | Environmental | | | | | | | Fuel availability | Fuel biomass (residuals)/plot | Fuel biomass (residuals)/farm |  |  | Biomass measurement | | Water availability | % of plants wilting | % of fields wilting |  |  | Field tests | | Soil biology | Total carbon (%) |  |  |  | Computer modeling | | | | | |
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| 6. Deliverables | Means of verification | | | Delivery date |
| 6.1 Long-term implications of intercropping systems on climate and market risks and resource use efficiency of smallholder farms assessed | Team project report (technical submitted to Africa RISING  Research Data collected, verified by upload on Dataverse.  Draft manuscript prepared and shared with Chief Scientist for review and record. | | | Sep. 2021 |
|  |  | | | |
| 7. How will scaling be achieved? | | | | |
| The main beneficiary of this sub-activity is the scientific community which will through publications, gain better insights into appropriate intervention strategies that increase resource use efficiencies, productivity, and profitability while reducing production risk. | | | | |
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| 8. How are the activities in this protocol linked to those of others? | | | | |
| The modeling outputs will inform better intervention strategies for doubled-up legumes, cereal-legume intercrops implemented by the Africa RISING community including ICRAF, TARI-Hombolo, and SUA (integrated soil fertility management), MSU-Malawi and ICRISAT NARS of Malawi. We will also work with the Systems agronomist (IITA) and the Michigan State University team of Malawi. | | | | |

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| 9. Gantt chart | 2020 | | 2021 | | | | | | | | | |
| Activity/ month | Oct/Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
| Complete modeling of Tanzania data |  |  |  |  |  |  |  |  |  |  |  |  |
| Conduct regional Modelling (Malawi and Tanzania) |  |  |  |  |  |  |  |  |  |  |  |  |
| Manuscript drafting of regional paper- 1 |  |  |  |  |  |  |  |  |  |  |  |  |
| Establishment of trials at two sites in Malawi |  |  |  |  |  |  |  |  |  |  |  |  |
| Field monitoring and data collection in Malawi |  |  |  |  |  |  |  |  |  |  |  |  |
| Conduct regional Modelling (Malawi & Tanzania) |  |  |  |  |  |  |  |  |  |  |  |  |
| Report and write up |  |  |  |  |  |  |  |  |  |  |  |  |
| Manuscript drafting of regional paper- 2 |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | |
| a. Output 5.1 | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | |
| b. Activity 5.1.2 | Use farm trial data to apply crop simulation models (APSIM) and assess performance over space and time, including assessment of climate-smart technologies to establish the potential for adaptation and mitigation | | | |
| c. Sub-activity 5.1.2.2 | Evaluate the potential contributions of integrated management around the five SIAF domains with emphasis on Africa RISING interventions in Tanzania | | | |
|  | | | | |
| d. Research team | | | | |
| Name | Institution | Role | | |
| Job Kihara | CIAT | PI  Lead ISFM team members to statistically analyze generated data, complete existing draft and submit to a journal | | |
| Mateete Bekunda | IITA | Provide reviews of the manuscript during its development cycle, and ensure cooperation by all team members | | |
| Julius Manda | IITA | Responsibility on economics components of the paper including whole farm benefits | | |
| Inviolate Dominick | WorldVeg | Responsible for aspects of ISFM around vegetable production | | |
| Patrick Okori | IITA | Contribute to maximization of genetic gain through ISFM | | |
| Anthony Kimaro  Eliherema Swai | ICRAF/  TARI Hombolo | Contribute to resilience arising from ISFM technologies e.g., tied ridges and improved varieties | | |
| Gundula Fischer | IITA | Thorough review and re-framing of issues around the social domain of soil fertility management and perceptions of outcomes. Also, contribute relevant data from Africa RISING work | | |
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| e. Student(s): Nil | | | | |
|  | | | | |
| f. Location(s) | Babati and Kongwa-Kiteto sites, Tanzania | | | |
|  | | | | |
| g. Start date | November 2019 | | | |
|  | | | | |
| h. End date | June 2021 | | | |
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| 1. Justification | | | | |
| During 2019/2020, major progress has been made to conceptualize and frame a draft on systems analysis of ISFM. A thorough review covering the 5 SIAF domains has been undertaken and Africa RISING made good progress in preparing in-house data to support quantitative assessments of the ISFM. Pulling this out as an Africa RISING product for public use still requires significant efforts to statistically analyze the inhouse Africa RISING datasets, properly integrate them into the draft, convert the draft into an actual manuscript for journal publication. The team spirit and rapport created during the implementation of this activity in the 2019/2020 season is a resource to build on. This activity is bringing out not only the effects of ISFM practices on productivity and economics but also addressing gaps, especially around the social and human domains of the SIAF. It is a system-wide assessment to inform performance overall as well as under different contexts, e.g., agro-ecological zones while taking the focus from mostly plot-level indicators to also community and landscape-level impacts. This activity is bringing out key considerations necessary for future evaluations of ISFM impacts. | | | | |
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| 2. Objectives | | | | |
| 2.1 To complete system-wide assessments of the effects of integrated soil fertility management around the five domains of SIAF in Tanzania, an activity started during 2019/2020 | | | | |
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| 3. Research questions | | | | |
| 3.1 How does ISFM influence indicators of the productivity, economic, environmental, social, and human domains? | | | | |
|  | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis: This is a system-wide analysis pulling data from several sources. We will statistically analyze existing Africa RISING data obtained from teams (mostly productivity and economics and combing through for the others) and write up those into the existing draft, translating it to a journal article. We have already conducted a literature review on the effects of ISFM, mostly on less understood domains, to complement the Africa RISING data. | | | | |
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| 5. Data (with metrics) to be collected and uploaded on Dataverse, as presented for 2019/2020 | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community/landscape metrics | Measurement method (details in research protocol) | | Productivity | | | | | | | Crop productivity | Maize, beans, pigeon pea productivity (kg/ha/season) - all team members | Maize, beans, pigeon pea productivity (kg/ha/season) - Julius, Job |  | Maize, beans, pigeon pea productivity (kg/ha/season) -Francis | Yield measurements and  Household survey | | Variability of production |  |  | Rating of production risk (in case studies)  - Gundula | Variability of NPP  - Francis | Farmer evaluation and  Remote sensing | | Biomass productivity | Maize, beans, pigeon pea and cowpea biomass productivity (kg/ha/season) | Maize, beans, pigeon pea and cowpea biomass productivity (kg/ha/season)  - multiple team members |  | Maize, beans, pigeon pea and cowpea biomass productivity (kg/ha/season) -Francis (for Malawi) | Yield measurements,  Household surveys and Remote sensing | | Residue production (kg/ha/season) | Residue production (kg/ha/season) -Anthony |  | Residue production (kg/ha/season) -Francis (for Malawi) | Yield measurements | | Rating of residue production |  |  | Rating of residue production (in case studies) -Gundula | Farmer evaluation | | Economic | | | | | | | Profitability | Gross margins ($/crop/ha/ season)  - all team members | Gross margins ($/crop/ha/ season)  - Julius | Net income (total net income for all farm activities) -Julius |  | Survey | | Labor requirement | Labor requirement (hours/ha) - (Julius Manda) |  | Farmer rating of labor - Julius |  | Household survey | | Variability of profitability | - all team members | - Julius (from surveys) | Probability of low profitability  -Julius |  | Household survey | | Market participation |  |  | % of maize sold to the market  - Julius |  | Household survey | | Environmental | | | | | | | Fuel availability | Fuel biomass (kg/ha/season)  -Job, Anthony and Patrick | Fuel biomass (kg/ha/season)  - Anthony (e.g. Maile’s whole farm) |  |  | Participatory exercise | | Soil physical quality | N-Fixation -Job |  |  |  | Soil tests | | Vegetative cover |  |  |  | % vegetative cover by type  % bare land  - Francis | Remote sensing | | Human condition | | | | | | | Nutrition | Protein production (g/ha) - all teams |  |  |  | Lookup tables and production data from surveys | | Food security | Food production (calories/ha/year) -all teams | Months of food insecurity; Rating of food security -Julius | Months of food insecurity; Rating of food security -Julius |  | Field measurement/ lookup tables | | Social | | | | | | | Gender equity |  |  | Income by gender -Gundula |  | Key informant interviews | | Rating of technologies by gender – Gundula |  | Rating of technologies by gender -Gundula |  | Key informant interviews | | Food security by gender (NB: These are qualitative evaluations so no metrics) – Gundula |  | Food security by gender (NB: These are qualitative evaluations so no metrics) -Gundula |  | Key informant interviews | | Equity |  |  | Rating of technologies by group -Gundula |  | Focus group discussions (for farmers hosting trials) | |  | | | | | | | | | | |
| As indicated in the activity plan for 2019/20, household level for with and without ISFM is be based on a categorization of households in the surveys undertaken. And households are at different levels of ISFM use. The community level can be an extrapolation of households to all the households within the community/landscape. | | | | |
|  | | | | |
| 6. Deliverables | | | Means of verification | Delivery date |
| 6.1 A submitted version of journal article on ISFM assessment across five domains | | | Confirmation from journal of article submission. Draft to be verified by Chief Scientist. | Sep. 2021 |
|  | | | | |
| 7. How will scaling be achieved? | | | | |
| Africa RISING teams involved in this activity will be exposed to the data formatting and analyses conducted. This is a co-learning and cross-hybridization of knowledge that can be used in further work. | | | | |
|  | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | |
| This activity is drawing information and data from all the planned activities for Africa RISING in Tanzania. Refer to the research team and their defined roles above. | | | | |

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| 9. Gantt chart | | | | | | | |
|  | 2020 | 2021 | | | | | |
| Activity/ month | Dec | Jan | Feb | Mar | Apr | May | Jun |
| Review of data from team members |  |  |  |  |  |  |  |
| Team members fill in existing gaps in data for ISFM analysis |  |  |  |  |  |  |  |
| Data from team members analyzed statistically |  |  |  |  |  |  |  |
| Data integrated into the draft manuscript |  |  |  |  |  |  |  |
| Review of the manuscript by chief scientist |  |  |  |  |  |  |  |
| Finalization of manuscript |  |  |  |  |  |  |  |
| Submission to journal |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | | | | | |
| a. Output 5.1 | | Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | | | | | | |
| b. Activity 5.1.6: | | Disseminate best-fit integrated crop-livestock technologies to reach and have an effect on small-scale farmers in a landscape context | | | | | | | | |
| c. Sub-activity 5.1.6.1 | | Small-scale piloting of FarmMATCH – a framework for typology-based targeting and scaling of agricultural innovations. (Matching Agricultural Technologies to Farms and their Context | | | | | | | | |
|  | | | | | | | | | | |
| d. Research team | | | | | | | | | | |
| Name | | | | | | Institution | Role | | | |
| Jeroen Groot | | | | | | WUR | Farming systems analysis (Activity Leader) | | | |
| Francis Muthoni | | | | | | IITA | GIS specialist | | | |
| Beliyou Haile | | | | | | IFPRI | Economic analysis | | | |
| Lieven Claessens | | | | | | IITA | Farming systems analysis | | | |
| Carlo Azzarri | | | | | | IFPRI | Economic analysis | | | |
|  | | | | | | | | | | |
| e. Students: Nil | | | | | | | | | | |
|  | | | | | | | | | | |
| f. Locations | Tanzania (Babati, Kongwa, Kiteto) and Malawi (Dedtza, Ntcheu) | | | | | | | | | |
|  | | | | | | | | | | |
| g. Start | 1 October 2019 | | | | | | | | | |
|  | | | | | | | | | | |
| h. End | 1 October 2021 | | | | | | | | | |
|  | | | | | | | | | | |
| 1. Justification | | | | | | | | | | |
| Increasingly, mobile phones and other ICT services are used to provide information and advice to farmers to facilitate learning. Support for targeting and scaling agricultural technologies through ICT tools is scarce. ICT-based targeting and scaling approaches should not be considered a silver bullet, although they can increase the reach and reduce the costs of technology dissemination compared to traditional village extension services.  Sophisticated models of technology integration in farming activities exist, but they are often very data-intensive and do not extend beyond the farm level. Muthoni *et al.* (2017[[27]](#footnote-27)) utilized spatially gridded biophysical and socio-economic layers to generate what they called “sustainable recommendation domains” (SRDs) that could be targeted for scaling specific technologies. The effectiveness of the suitability assessment can be further refined as long as the features of individual farms are considered and directly related to technology characteristics during the targeting phase. Innovations in coupling knowledge among site characteristics, household features, and technology attributes with the SRDs are needed to guide spatial targeting of suitable technologies.  The FarmMATCH approach explicitly tries to fill this knowledge gap, facilitating the matching between agricultural technologies to farms and their context. It contains 1) a learning and matching algorithm that identifies the most suitable and promising technologies for different farm types, and 2) a data mining and signaling algorithm that identifies hotspots of the suitability of technologies and potential adopters. The matching algorithm combines contextual, farm, and technology characteristics to create a ranking of the suitability and adoption probability of available innovations. | | | | | | | | | | |
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| 2. Objectives | | | | | | | | | | |
| 2.1 Test and improve the ‘matching’ algorithm on a large dataset | | | | | | | | | | |
| 2.2 Determine the ease of scarce data collection at farms | | | | | | | | | | |
| 2.3 Obtain feedback from farmers on the technology priority lists | | | | | | | | | | |
| 2.4 Develop a mechanism for feeding collected data to the database and improve algorithm learning | | | | | | | | | | |
| 2.5 Develop the ‘signaling’ algorithm | | | | | | | | | | |
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| 3. Research questions | | | | | | | | | | |
| 3.1 What is the quality of the generated priority lists for large samples of farms in different agroecological and socio-economic conditions? | | | | | | | | | | |
| 3.2 Can the necessary set of scarce data be collected swiftly and reliably from farmers upon farm visit? | | | | | | | | | | |
| 3.3 What are farmers’ perception of the generated priority list of technologies suggested for implementation? | | | | | | | | | | |
|  | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | |
| Experiment design, implementation, and data analysis   * Data collection: GIS and ARBES databases for intervention areas in Tanzania and Malawi will be used to select 1 km2 grid cells with surveyed households. A minimal set of supplementary data on farm and household features and on-farm technologies and practices may be collected. * We select 35-50 grid cells of 1 km2 from the three regions of Tanzania (Babati, Kongwa, Kiteto) and two districts in Malawi (Dedtza, Ntcheu), so 5-10 cells per region. These cells differ in biophysical conditions (soil, rainfall, etc.) and socio-economic circumstances (e.g. distance to market). Moreover, within these cells we have at least 10 households sampled within the ARBES database collected by IFPRI; if this is not the case then additional data collection is required. In total ca. 300 farms will be included. There should also be diversity among the sampled households in the grid cell. For each household, we analyze in particular the main, easy-to-collect farm and household features (size, objectives, livestock, crop number, % off-farm income, etc.) and relate these to the farm practices and project-proposed technologies and techniques. The matching algorithm combines the GIS-derived data on biophysical conditions and socio-economic context circumstances with the farm features, to estimate the probability of use of the various technologies and techniques. The data set will be divided between a training set (n=200-240) and a testing set (n=60-100). | | | | | | | | | | |
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| 5. Data (with metrics) to be collected and uploaded on Dataverse. Generally, not applicable given that a tool is being piloted, rather than validating a technology. However, the information below will be collected. | | | | | | | | | | |
| Domain | | | | Indicator | | | | Metric and scale | | |
| Non-domain data: | | | | Compiled datasets  Programmed algorithms | | | |  | | |
| Human condition | | | | Capacity to experiment | | | | Willingness to implement a new farm configuration after disturbance | | |
| Social | | | | Equity | | | | Rating of farm configurations per group and agency (leadership roles) | | |
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| 6. Deliverables | | | | | Means of verification | | | | Delivery date | |
| 6.1 Journal article submitted | | | | | PDF of submitted papers, verified by Chief Scientist | | | | 1 Apr. 2021 | |
| 6.2 Technical report | | | | | PDF report | | | | 1 Feb. 2021 | |
| 6.3 Datasets and algorithms | | | | | Items uploaded in Dataverse | | | | 1 Jun. 2021 | |
| Note: these deliverables were also in the 2019-20 workplan. Due to delays, these will be submitted in 2021. | | | | | | | | | | |
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| 7. How will scaling be achieved? | | | | | | | | | | |
| The modeling results will be discussed in farmer meetings. Findings will be shared and published. | | | | | | | | | | |
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| 8. How are activities in this protocol inked to those of others? N/A | | | | | | | | | | |
|  | | | | | | | | | | |
| 9. Budget: no new funds required: funds carried over from the 2019-2020 budget | | | | | | | | | | |
| Budget Line | | | WUR | | | | | IITA | | IFPRI |
| Personnel | | | 4,000 | | | | |  | |  |
| Services | | | 1,000 | | | | |  | |  |
| Supplies | | | 1,000 | | | | |  | |  |
| Capital | | | 0 | | | | |  | |  |
| Travel | | | 3,000 | | | | |  | |  |
| Overhead | | | 600 | | | | |  | |  |
| Total | | | 9,600 | | | | |  | |  |

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| 10. Gantt chart | 2020 | | | 2021 | | | | | | | | |
| Activity/ month | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Analysis |  |  |  |  |  |  |  |  |  |  |  |  |
| Write report |  |  |  |  |  |  |  |  |  |  |  |  |
| Write article |  |  |  |  |  |  |  |  |  |  |  |  |
| Revise article after review |  |  |  |  |  |  |  |  |  |  |  |  |
| Submit data |  |  |  |  |  |  |  |  |  |  |  |  |

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| a. Output 5.1: Opportunities for the use and adoption of sustainable intensification technologies identified for relevant farm typologies | | | | | | | | | | | | | | | | | | |
| b. Activity 5.1.7: Conduct cost-benefit and gender analysis coupled with other socio-economic analyses to identify and quantify adoption constraints and opportunities for different farmer contexts | | | | | | | | | | | | | | | | | | |
| c. Sub-activity 5.1.7.4. Assess the effect of tied ridging, residual tied and rip tillage on maize productivity, net crop returns, household income and food security | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| d. Systems research team: | | | | | | | | | | | | | | | | | | |
| Name | | Institution | Role | | | | | | | | | | | | | | | |
| Julius Manda | | IITA | PI, design of data collection tools, coordinate survey and data analysis | | | | | | | | | | | | | | | |
| Daniel Mgalla | | IITA | M&E Support | | | | | | | | | | | | | | | |
| Francis Muthoni | | IITA | GPS measurement of plots and sampling | | | | | | | | | | | | | | | |
| Gundula Fischer | | IITA | Support for capturing gender aspects in the socio-economic data | | | | | | | | | | | | | | | |
| Lieven Claessens | | IITA | Systems analysis | | | | | | | | | | | | | | | |
| Elirehema Swai | | TARI-Hombolo | Information and data on the SWC technologies and development of the sampling frame | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| e. Students: Nil | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| f. Locations: | Kongwa and Kiteto districts of Tanzania | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| g. Start date | October 2019 | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| h. End date | September 2021 | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | | | | | |
| This activity is a continuation of the 2019-2020 season. The soil and water conservation technologies—tied and residual tied ridging, rip tillage, and fanya-juu terracing— are unique in that they are both labor-intensive, hence in analyzing the effect of these technologies on the welfare of smallholder farmers. Since most of the Africa RISING work is on demonstrating the importance of these technologies at plot level (except fanya juu), understanding why farmers are using or not using these SWC technologies at a larger scale is important, especially in terms of scaling up the adoption of the technologies. Apart from showing the economic returns of these technologies, the results of this study will provide important feedback and information to the project and policymakers on the socio-economic factors that prevent and enhance the adoption of these technologies on a wider scale. Details are given in the appended protocols. | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | | | | | |
| 2.1 To examine the socio-economic and community factors affecting the use and non-use of tied ridging, residual tied ridging, rip tillage, and Fanya-juu terracing | | | | | | | | | | | | | | | | | | |
| 2.2 To assess the effect of tied ridging/residual tied ridging, rip tillage, and Fanya-juu terracing on maize yields, net returns, household income, asset ownership and food security | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | | | | | | | | |
| 3.1 What are the social-economic and community factors affecting the use of soil and water conservation technologies? | | | | | | | | | | | | | | | | | | |
| 3.2 What are the productivity, income, and food security effects of adopting soil and water conservation technologies? | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | | | | | |
| Experiment design, implementation, and data analysis  A household survey was done in September 2020 involving 578 sample households in Kiteto and Kongwa district in the central region of Tanzania. The households were randomly selected from a population of both users (including host farmers of the research trials) and non-users of the SWC technologies. The development of a sampling frame from which a sub-sample of users and non-users of SWC technologies was selected randomly was done in collaboration with TARI-Hombolo. A survey questionnaire was prepared and administered by trained enumerators who will collect data from households through personal interviews. Specifically, data collection was done using computer-assisted personal interviewing (CAPI) based software, *survey be*. Information on labor, gender, maize production, asset ownership, and socio-economic characteristics was collected through this survey.  To estimate the economic benefits of tied and residue tied ridging, rip tillage and fanya-juu terracing, profitability and cost-benefit analysis will be conducted using data from the survey, supplemented with the data from the research trials. Second, to assess the factors affecting the use and effect of tied and residue tied ridging, rip tillage and Fanya-juu’ terracing on maize productivity, net returns, household income, asset ownership, and food security, the Endogenous Switching Regression (ESR) will be used. This econometric method will be used because the data which will be collected in the survey is cross-sectional which is prone to selection bias and endogeneity. This is because the use of tied and residue tied ridging, rip tillage and fanya-juu terracing may be voluntary or some of the farmers may have been targeted to use these technologies depending on their innate abilities such as management ability. Not accounting for this may under- or overstate the true effect of the technology. To fully account for this, the ESR model is used as it allows the grouping of farmers into users and non-users of the technology and therefore enables one to account for the differential responses of the two groups. | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 5. Data (with metrics) to be uploaded on Dataverse | | | | | | | | | | | | | | | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community /landscape metrics | Measurement method | | Productivity | | | | | | | Crop productivity | Maize yield (kg/ha) |  |  |  | Data will come from sub-activity 1.2.1.1/household survey | | Input use efficiency | Product per input |  |  |  | (same as above for crop productivity) | | Economic | | | | | | | Profitability | Gross margin ($/ha) | Net income (total net income for all farm activities) | Net income (total net income for all farm activities) ($/capita) |  | Household survey | | Poverty |  |  | Asset index |  | Household survey | | Market participation |  |  | Market participation: % of maize sold to the market |  | Household survey | | Environmental[[28]](#footnote-28) | | | | | | | Pesticide use | Active ingredient applied per ha | Active ingredient applied per ha |  |  | Household/agricultural survey | | Human | | | | | | | Food security | Food production (Calories/ha/year) | Food production (Calories/ha/year) | Months of food insecurity |  | Household survey | | Protein production | Protein production (g/ha) |  |  |  | Household survey and  lookup tables | | Social | | | | | | | Collective action |  |  | Participation in a collective action group | Participation in a collective action group | Household survey | | Gender equity | Management control by gender |  | Market participation by gender | Participation in social groups | Household survey | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 6. Deliverables: | | | | | Means of verification | | | | | | | | | Delivery date | | | | |
| 6.1 Socio-economic and community factors affecting the use and non-use of tied ridging, residual tied ridging, rip tillage and fanya-juu terracing identified  6.2 The effect of tied ridging, residual tied ridging, rip tillage and fanya-juu terracing on maize yields, net returns, household income, asset ownership, and food security analyzed | | | | | Draft manuscript, verified by the Chief Scientist | | | | | | | | | Apr. 2021. | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 7. How will scaling be achieved | | | | | | | | | | | | | | | | | | |
| The scaling approaches have been described in sub-activities 1.2.2.1 and 2.2.1.6 (in the 2019/2020 workplan) | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others? (*note that these are activities for the 2019/2020 season*) | | | | | | | | | | | | | | | | | | |
| This sub-activity is linked to the following sub-activities:  Sub-activity 1.2.1.1: Validation of residual tied ridging as a labor-saving technology in semi-arid Areas of Central Tanzania (PI: Elirehema Swai, TARI-Hombolo).  Sub-activity: 1.3.1.2: Produce regionally relevant extrapolation domain maps for validated soil and water conservation practices (*Gliricidia sepium*- shelterbelt, Tied Ridges, and Fanya Juu/chini) (PI: Francis Muthoni, IITA).  Sub-activity 1.2.2.1: Use of tractor mounted rip tillage implement for enhancing soil water infiltration and moisture conservation in semi-arid areas of Kiteto, Manyara Region (PI: Gundula Fischer, IITA).  Sub-activity 1.3.1.3: Ex-ante impact assessment with Trade-off Analysis Model for Multi-Dimensional Impact Assessment (TOA-MD) for regional relevance of Africa RISING technologies (PI: Lieven Claessens, IITA). | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 9. Budget in USD | | | | | | | | | | | | | | | | | | |
| Consultant/ research assistant to organize soil and water conservation survey data @ USD 60 for 30 days | | | | | | | | | | | 1,800 | | | | | | | |
| TOTAL | | | | | | | | | | | 1,800 | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| 10. Gantt chart | | | | 2020 | | | | | 2021 | | | | | | | | | |
| Activity/ month | | | | Sep | | Oct | Nov | Dec | Jan | Feb | | Mar | Apr | | May | Jun | Jul | Aug |
| Data cleaning and analysis | | | |  | |  |  |  |  |  | |  |  | |  |  |  |  |
| Draft manuscript write-up | | | |  | |  |  |  |  |  | |  |  | |  |  |  |  |

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| Project Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | |
| a. Output 5.2: | Strategic partnerships with public and private, initiatives for the diffusion, and adoption of research products | | | |
| b. Activity 5.2.2 | Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways | | | |
| c. Sub activity 5.2.2.1 | Support the Ministry of Agriculture and NGO Extension in scaling CA-systems In Eastern Zambia and Malawi and develop legacy knowledge products for conservation agriculture and related technologies to be used by farmers beyond the project lifetime | | | |
|  | | | | |
| d. Systems research team: | | | | |
| Name | Institution | Role | | |
| Christian Thierfelder | CIMMYT | PI, design of knowledge products | | |
| Regis Chikowo | MSU | Design of knowledge products | | |
| Mphatso Gama | Machinga ADD | Implementation | | |
| Mulundu Mwila | ZARI | Implementation | | |
| Richard Museka | TLC | Implementation | | |
|  | | | | |
| e. Student(s): Nil | | | | |
|  | | | | |
| f. Location(s): | NA | | | |
|  | | | | |
| g. Start date | October 2020 | | | |
|  | | | | |
| h. End date | September 2021 | | | |
|  | | | | |
| 1. Justification | | | | |
| For adaptation, adoption, and sustainable uptake, we need to co-develop technologies with local partners and engage at different levels. We intend to share research results with different audiences at different levels and at different times within the target countries. This will be achieved in targeted meetings during the field days, evaluation meetings, and other broader meetings during the cropping season (provided COVID allows for travel). In addition, our partners will engage with the national information service to conduct radio programs and roadshows for wider coverage.  Finally, the project team will put together a range of knowledge products aimed at farmers in the target areas to enhance their knowledge and encourage uptake. | | | | |
|  | | | | |
| 2. Objectives | | | | |
| To enhance the scaling of conservation agriculture in rural communities of Malawi and Zambia | | | | |
|  | | | | |
| 3. Research questions NA | | | | |
|  | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | |
| Experiment design, implementation, and data analysis  Ministry of Agriculture and NGO partners will be actively involved in the management and evaluation of on-farm trials to get first-hand experiences and data of the technologies to be scaled. We plan to share data and knowledge with local partners in various events (see below). | | | | |
|  | | | | |
| 5. SI Domain (no specific domain will be addressed as the activity will not involve taking field-level data but is more directed at creating an enabling environment) | | | | Responsible institution |
|  | | | | |
| 6. Deliverables | | | Means of verification | Delivery date |
| 6.1 Evaluation meetings of technology interventions | | | Field protocols and data | Mar. 2021 |
| 6.2 Study tours with key players | | | Study tour report | Feb./Mar. 2021 |
| 6.3 Field days conducted | | | Annual reports | Sep. 2021 |
| 6.4 Roadshows and radio programs conducted | | | Annual reports | Sep. 2021 |
| 6.5 Three success stories published | | | Annual reports | Sep. 2021 |
| 6.6 Five Knowledge products developed, produced in simplified language, and shared with farmers | | | Knowledge products | Sep. 2021 |
| 6.7 CA systems scaled at least to 10,000 farmers in Malawi and Zambia | | | Annual Report, adoption monitoring | Sep. 2021 |

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| 7. How will scaling be achieved? |
| Scaling will be achieved through active involvement of the Ministry of Agriculture Staff in Zambia and Malawi, interested NGO and long-term partners (TLC), involvement of district committee personnel in field and study tours, field days, demonstrations, and other community-based activities. Three types of scaling will be targeted: Scaling out (spatial scaling), scaling-up (make institutions change), and scaling deep (achieve a behavior change by farmers). |
|  |
| 8. How are the activities in this protocol linked to those of others? |
| * This activity will be mainly bilateral but will include at various stages other players from MSU and IITA |

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| 9. Gannt chart | 2021 | | | | | | | | |
| Activity | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Evaluation meetings |  |  |  |  |  |  |  |  |  |
| Field and study tours |  |  |  |  |  |  |  |  |  |
| Roadshows and radio programs |  |  |  |  |  |  |  |  |  |
| Knowledge products |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Delivery and uptake of SI innovations through building functional partnerships among research and development institutions enhanced | | | | | |
| a. Output 5.2 | Improved mechanisms for effective linkages and strategic partnerships with public, private, and other initiatives for the release, diffusion, and adoption of validated technologies established | | | | |
| b. Activity 5.2.2 | Map and assess relevant stakeholders to establish dialogue for the exploration of mutual synergies for scaling delivery of validated technologies | | | | |
| c. Sub-activity 5.2.2.3 | Partnership with Iles de Paix (IDP) for increasing the adoption of improved vegetable varieties and good agricultural practices (GAP) in vegetable production in 9 new villages in Karatu | | | | |
|  | | | | | |
| d. Scaling team: | | | | | |
| Name | | Institution | Role | | |
| Ludovic Joly | | Iles de Paix (IDP) | PI | | |
| Sognigbe N’Danikou | | WorldVeg | Technical backstopping of the scaling activities by IDP | | |
| NN | | IITA/IFPRI | M&E Support | | |
|  | | | | | |
| e. Students: Nil | | | | | |
|  | | | | | |
| f. Locations: | | 9 Villages in Karatu | | | |
|  | | | | | |
| g. Start date | | November 2019 | | | |
|  | | | | | |
| h. End date | | 31 March 2021 | | | |
|  | | | | | |
| 1. Justification | | | | | |
| Partnership with IDP will ensure scaling out of vegetable technologies to reach several farmers in Karatu District. Through, scaling, other development agencies or initiatives that aim at taking technologies to scale like public and private extension services and a range of value chain actors would be interested in the technologies. The evidence base generated through this widespread scaling by IDP will help to catalyze further partnerships within the entire District that will put promising technologies and integrated interventions in the hands of millions of target rural households. WorldVeg will support IDP scaling approaches with technical backstopping and monitoring of scaling activities. | | | | | |
|  | | | | | |
| 2. Objectives | | | | | |
| To build the capacity of staff of IDP to efficiently scale out the vegetable technologies in 9 villages. | | | | | |
|  | | | | | |
| 3. Research questions NA | | | | | |
|  | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | |
| Experiment design, implementation, and data analysis:  Within the village: Targeted 350 direct beneficiaries of the program must support at least 3 farmers from his/her village with at least one technique or technology he benefited or learned from the program (350\*3= 1050 farmers). WorldVeg will support IDP to track the beneficiaries of the technologies as required by USAID FTF indicator guidelines. | | | | | |
|  | | | | | |
| 5. Data (with metrics) to be uploaded on Dataverse | | | | | |
| Feed the Future (FTF) to be collected (Note: This being a scaling activity, collection of SIAF domains data is not applicable). | | | | | |
| |  |  | | --- | --- | |  | 2020 Target | | EG.3.2-25 Number of hectares under improved management practices or technologies with USG assistance [IM-level] | 24 | | EG.3.2-24 Number of individuals in the agriculture system who have applied improved management practices or technologies with USG assistance [IM-level], | 818 | | Value chain actor type: People in government | 15 | | EG.3.2-2 Number of individuals who have received USG-supported degree-granting non-nutrition-related food security training [IM-level] | 3 | | EG.3.2-7. Number of technologies, practices, and approaches under various phases of research, development, and uptake as a result of USG assistance [IM-level] | 4 | | | | | | |
|  | | | | | |
| 6. Deliverables: | | | | Means of verification | Delivery date |
| Provide technical backstopping to IDP to efficiently scale the technologies in 9 villages | | | | Technical report | Mar. 2021 |
|  | | | | | |
| 7. How will scaling be achieved? NA | | | | | |
|  | | | | | |
| 8. How are the protocols of this research linked to those of others? NA | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9. Gantt chart | | 2020 | | | | | | 2021 | | |
| Activity/ month | | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar |
| Introduction and promotion of improved varieties and good agricultural practices (GAP) in new and old villages (Lead-WorldVeg) | Good agricultural practices (GAP) and IPM practices |  |  |  |  |  |  |  |  |  |
| Proper harvesting and post-harvest principles and technologies |  |  |  |  |  |  |  |  |  |
| Data collection/seasonal transects/FGD |  |  |  |  |  |  |  |  |  |
| Community empowerment (Lead: WorldVeg) | 1 Field day |  |  |  |  |  |  |  |  |  |
| Backstopping IDP to scale improved management practice in new villages (Lead: IDP) | Participate in awareness creation (vegetable farming as a business (value chain thinking) |  |  |  |  |  |  |  |  |  |
| Train IDP staff how to effectively scale out the improved technologies |  |  |  |  |  |  |  |  |  |
| Nutrition training in new villages (Lead: WorldVeg) | Nutrition message training |  |  |  |  |  |  |  |  |  |
| Train food kiosks on recipe preparation and evaluate recipe acceptability |  |  |  |  |  |  |  |  |  |
| Focus groups discussions and Key informant interviews (KII) to assess collective action activities |  |  |  |  |  |  |  |  |  |
|  | Survey/FGD to assess/monitor the uptake of nutritious recipes |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | |
| a. Output 5.2 | | Strategic partnerships with public and private, initiatives for the diffusion, and adoption of research products established | | | | |
| b. Activity 5.2.2 | | Leverage/link and integrate (engagement and outreach) with existent initiatives including Government extension systems to support and encourage the delivery pathways | | | | |
| c. Sub-activity 5.2.2.7 | | Partnership with LEAD Foundation to take to scale soil and water management technologies in erosion-prone areas of Central Tanzania | | | | |
|  | | | | | | |
| d. Research team | | | | | | |
| Name | | Institution | Role | | | |
| Elirehema Swai | | TARI Hombolo | PI will liaise with LEAD Foundation, extension officers, and lead farmers | | | |
| Director -LEAD Foundation | | LEAD Foundation | Providing a platform for engagement of champions and farmers who have installed terraces in their field | | | |
| Anthony Kimaro | | ICRAF | Coordinate with the LEAD Director on multipurpose tree species for reinforcing the bunds | | | |
|  | | | | | | |
| e. Students: Nil | | | | | | |
|  | | | | | | |
| e. Location(s): | Chamwino, Chemba, Mpwapwa, Kondoa and Kongwa Districts in semi-arid of Dodoma Region | | | | | |
|  | | | | | | |
| f. Start date | | 2019/2020 | | | | |
|  | | | | | | |
| g. End date | | Sept 2021 | | | | |
|  | | | | | | |
| 1. Justification | | | | | | |
| Africa RISING since 2014/2015 cropping season has invested substantial resources in developing and validating best technologies for addressing the problem of land degradation in semi-arid areas of Central Tanzania. These initiatives were geared to controlling soil erosion using Fanya juu/chini terrace technology, with the integration of Napier grass and Gliricidia multi-purpose tree on contour bunds for reinforcement. The identification of partners who are ready to engage and scale these technologies to other places with similar conditions is important. In July 2019, the LEAD Foundation, a non-governmental organization based in Dodoma Region which is engaged in environmental conservation, identified Fanya juu as their technology of interest. Africa RISING researchers were consulted and “Memorandum of Understanding” was therefore signed on modalities of partnering to scale it up (see Appendix 2). The LEAD Foundation requested Africa RISING implementing partners to support them by providing technical backstopping to lead farmers on matters regarding the installation of Fanya juu/chini terraces at plot level and community levels during the 2019/2020 and 2020/2021 cropping seasons. | | | | | | |
|  | | | | | | |
| 2. Objectives | | | | | | |
| 2.1 To strengthen the capacity of extension staff in participating villages and lead farmers for an efficient rollout of soil and water management technologies | | | | | | |
| 2.2 To showcase the best bet methods of conserving soils during agricultural show famous as Nane Nane grounds for reaching wider farming communities | | | | | | |
| 2.3 To conduct farmers field days to showcase on how Fanya juu/chini terrace technologies are effective in controlling soil erosion | | | | | | |
| 2.4 To gather information on the number of farmers who have installed Fanya juu/chini terraces and the total area subjected to Fanya juu/chini terrace | | | | | | |
|  | | | | | | |
| 3. Research questions | | | | | | |
| 3.1 This is a scaling activity; no research questions are formulated | | | | | | |
|  | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | |
| Experiment design, implementation, and data analysis  LEAD Foundation started the rollout of Fanya juu terrace technology in four districts of the Dodoma region namely Chamwino, Chemba, Mpwapwa, and Kongwa during the 2019/2020 cropping season. Training of champion farmers for rollout in their respective villages was implemented. During the 2020/2021 cropping season, the following activities will be implemented:  4.1 Capacity building of key implementers  Arising from the training needs assessment results, capacity building of extension staff in participating villages and lead farmers will be implemented.  4.2 Set up of demonstration on Fanya juu/chini terrace technology  Installation of Fanya juu/chini terrace at demonstration plots in at least 5 villages in all 4 districts thus giving a total of 20 demonstrations, and the NaneNane show grounds.  4.3 Conduct farmers' field days  In collaboration with LEAD Foundation farmers’ field day will be conducted across sites to showcase how Fanya juu/chini terrace technologies are effective in controlling soil erosion.  4.4 Data collection  Information will be collected on the following: (i) area installed with Fanya juu/chini terraces. (ii) Number of farmers reached during 2019/2020 cropping (iii) farmer challenges and adaptation. | | | | | | |
|  | | | | | | |
| 5. Data to be collected and uploaded on DataVerse | | | | | | |
| These data relate to the FtF indicators | | | | | Responsible institution | |
| Number of extension and lead farmers trained | | | | | TARI Hombolo, LEAD Foundation | |
| Number of Fanya juu/chini terrace demonstrations established during 2020/2021 cropping season | | | | | TARI Hombolo, LEAD Foundation | |
| Number of beneficiaries installed Fanya juu terrace in their fields during 2020/2021 quantified | | | | | TARI Hombolo, IITA, ICRAF | |
| Acreages with Fanya juu terrace in target districts in erosion-prone areas of central Tanzania | | | | | TARI Hombolo, IITA, ICRAF, LEAD Foundation | |
|  | | | | | | |
| 6. Deliverables | | | | Means of verification | | Delivery date |
| 6.1 At least twenty (20) demonstration sites installed with Fanya juu terrace established | | | | Mid-term report submitted to Project Leader | | Mar. 2021 |
| 6.2 At least 50 hectares owned by champion farmers installed with Fanya juu terrace during 2020/2021cropping season | | | | Final technical report submitted to Project leader | | Sep. 2021 |
| 6.3 At least 100 extension officers across participating districts trained on the use of Fanya juu terrace technology during 2020/2021 through LEAD/Africa RISING partnership | | | | Training Report included in the technical report submitted to Project Leader | | Jul. 2021 |
| 6.4 At least 300 farmers exposed to Fanya juu/chini terrace technology during agricultural shows, i.e., Nane Nane ground | | | | Exposure Report submitted to Project Communication Officer | | Aug. 2021 |
| 6.5 Validation of Swahili version of SWC training manual | | | | Training manual validation report | | Jan. 2021 |
| 6.5 Swahili training material on control of soil erosion | | | | Training material submitted to Project Communication Officer | | Apr. 2021 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9. Gantt chart | 2020 |  | 2021 | | | | | | | | | |
| Activity/ month | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | | Jul | Aug | Sep |
| Planning meeting with LEAD Foundation on implementation strategies |  |  |  |  |  |  |  |  | |  |  |  |
| Continue with capacity building of extension workers villages and lead farmers in participating villages in 2020/2021 cropping season |  |  |  |  |  |  |  |  | |  |  |  |
| Continue to establish demonstration on Fanya juu /chini terrace in 2020/2021 cropping season to showcase practice |  |  |  |  |  |  |  |  | |  |  |  |
| Collect data on number of fields installed with Fanya juu terraces, numbers of farmers reaching |  |  |  |  |  |  |  | |  |  |  |  |
| Data entry and processing |  |  |  |  |  |  |  | |  |  |  |  |
| Report writing |  |  |  |  |  |  |  | |  |  |  |  |
| Dataverse uploading |  |  |  |  |  |  |  | |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | | | |
| a. Output5.3 | Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners. | | | | | | | |
| b. Activity 5.3.1 | Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies | | | | | | | |
| c. Sub-activity 5.3.1.1 | Role of gender from farm-to-fork and the market, of dryland cereals in Kiteto and Kongwa | | | | | | | |
|  | | | | | | | | |
| d. Research team | | | | | | | | |
| Name | Institution | | Role | | | | | |
| Patrick Okori | ICRISAT | | PI, conceptualize and design studies to answer the research questions, coordinate assembly of data from both research and monitoring activities | | | | | |
| Wanjiku Gichohi | ICRISAT | | CoPI, engage with other Africa RISING local and CGIAR partners | | | | | |
| Daniel Mgalla | IITA | | Provide support in monitoring of the research activities to ensure compliance to FtF monitoring system and uploading of data into the FtF data management system | | | | | |
|  | | | | | | | | |
| e. Student(s): Nil | | | | | | | | |
| Name | | Institute | | | Degree | Start | | End |
| Felista Saluti | | Sokoine University of agriculture | | | MSc. Policy Planning and Management | March 2019 | | March 2021 |
|  | | | | | | | | |
|  |  | | | | | | | |
| f. Location(s)  District, Village | Kongwa District, Villages-Chitego, Mlali, Laikala or Moleti; Kiteto District- Villages-Njoro or Kiperesa | | | | | | | |
|  |  | | | | | | | |
| g. Start date | November 2018 | | | | | | | |
|  |  | | | | | | | |
| h. End date | September 2021 | | | | | | | |
|  | | | | | | | | |
| 1. Justification | | | | | | | | |
| The team has used community seed banks for scaling-out improved resilient and productive varieties of legumes and dryland cereals in Kongwa and Kiteto districts of central Tanzania, between 2016-2017 and 2017-2018 cropping seasons. Farmers who accessed sorghum and pigeon pea seed used it for grain and seed production. Since many of these farmers are women, and the selected crops are generally food security crops, provide pre-conditions for gender studies. Studies elsewhere show that as women’s control of household income improves, it positively influences their decisions on expenditures related to food, health, and care for children. In this study, in which we collected data from both beneficiaries and non-beneficiaries of the pigeon pea seed bank, empowerment was assessed through a comparison between both categories of beneficiaries. We hypothesize that access to improved seed leads to empowerment. Furthermore, we assume that since pigeon pea is a nutritious crop with commercial potential, improved access to quality seed, invariably improves maternal and child nutrition outcomes. This could be through direct consumption or increased income accrued from grain sales. The income from grain sales could be used to purchase other nutrient-dense foods. Additionally, we hypothesize that women who receive improved seed have more power to negotiate, more time for household and care tasks, and therefore have more impact upon their own and their children’s nutrition outcomes.  In the 2018-2019 project year, our study focused on pigeon pea community seed banks as one of the avenues for technology delivery to the farming communities and how this is linked to women empowerment and the impacts on maternal and nutrition status. The preliminary findings from the study indicate that: (a) Significantly higher proportion of beneficiaries meet minimum dietary diversity-women (MDDW) compared to non-beneficiaries; (b) Similarly, a significantly higher proportion of children from beneficiary households meet dietary diversity and a significantly higher proportion of women were empowered, having greater control of resources in cases where women were the primary recipients of seed compared to cases when men received seed,  The study is crucial for understanding whether legume and cereal community seedbanks can contribute to better nutrition and health outcomes for vulnerable populations. Social inequity and social inclusion are important for development (Anonymous, 2015[[29]](#footnote-29)). These issues are also critical for nutrition and income improvement. Over time, there is evidence that increased equal gender relationships within households and communities, lead to better agriculture and development outcomes, including improved farm productivity and family nutrition (Abakerli, 2012[[30]](#footnote-30)). Such benefits have profound impacts on households and communities hence the need for this study. These initial findings, notwithstanding, require further analysis and correction for confounding factors such as wealth. We would also like to conduct the project-level women empowerment in agriculture index (PRO-WEAI) analysis associated with nutrition outcomes. The final analyses and development of the manuscript have to be finalized in 2021. In the 2020-2021 project year, our studies will focus on sorghum community seed banks and compare empowerment and its impact on maternal and nutrition status of beneficiary households with of the beneficiary households of pigeon pea seed community banks. This additional study aims to investigate the benefits of access to improved cereal seed on maternal and child nutrition outcomes. It is anticipated that this may be different from results obtained for legumes, given that sorghum is largely grown for home consumption and is seldom sold for income, unlike pigeon pea which serves both food and income sources. Additionally, the two studies will identify synergies for setting up cereal or legume community seedbanks with a goal to deliver nutrition and health outcomes, especially to vulnerable communities. | | | | | | | | |
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| 2. Objectives | | | | | | | | |
| 2.1 To examine the association between women's empowerment in agriculture and nutritional status among children within the first 1,000 days in the project life cycle in Kongwa-Kiteto. These women are members of community seed banks and use the productivity-enhancing innovations. | | | | | | | | |
| 2.2 To examine the association between women's empowerment in agriculture and nutritional status among women of reproductive age (15-49 years) within the project life cycle in Kongwa and Kiteto | | | | | | | | |
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| 3. Research questions | | | | | | | | |
| 3.1 Does being a beneficiary of the community seedbank empower recipients and result in improved maternal and child nutrition outcomes? | | | | | | | | |
| 3.2 Does the gender of the recipient of the seed matter? That is, do we observe significant differences in maternal and child nutrition outcomes based on the gender of the seed recipient? | | | | | | | | |
|  | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | |
| Experiment design, implementation, and data analysis  The community seed banks provide an easy mechanism for scaling out improved crop varieties. Members of the seed bank may use part of the grain/seed for domestic consumption and/or may sell to gain income for their livelihoods. Community seed banks, therefore, provide an opportunity to test the potential linkage between access, utilization of new technologies, and livelihood outcomes. Accordingly, this study is instituted to investigate the extent to which Africa RISING technologies (seed) may have positive outcomes on gender, nutrition, and household income. The study will be executed through surveys and assessments such as focused group discussions, rapid rural appraisals, and farming system surveys to identify gender and dietary gaps among the community seed bank beneficiaries. This will inform the development of nutrition-sensitive packages, that also promote gender equity in central Tanzania through the community beneficiaries we work with. Different methods of sampling including random and purposive sampling will be used. Questionnaires will be used as the data capture tool. Both qualitative and quantitative data will be captured. Appropriate statistical tools will be used in the data analysis. To address empowerment issues related to nutrition and health, the recently released FtF-USAID [project-Level Women’s Empowerment in Agriculture Index (pro-WEAI)](http://weai.ifpri.info/versions/pro-weai/) tool developed by IFPRI will be used. An expanded description of the design is given in the Research Protocols 2018-2019 – Appendix 1. | | | | | | | | |
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| 5. Data to be collected and uploaded on DataVerse | | | | | | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/farm/household metrics |  |  | Community/landscape metrics | Measurement method (details in research protocol) | | Social | | | | | | | Gender Equity | Agency: Time allocation by gender  Market participation by gender  Achievements:  Income by gender  Nutrition/Food security by gender  Health status by gender |  |  | Women Empowerment in Agriculture Index | Individual survey  Focus group discussions  Household survey | | Social cohesion | Level and reliability of social support  Participation in community activities |  |  | Participation in social groups | Focus group discussions  Household survey | | Human condition | | | | | | | Food security | Food availability |  |  |  | Survey | | Capacity to experiment | Number of new practices being tested |  |  | % of farmers experimenting | Focus group discussions | | | | | | | | | |
|  | | | | | | | | |
| 6. Deliverables | | | | Means of verification | | | Delivery date | |
| 6.1 Information on level of women empowerment as a result of access to improved technologies and groups dynamics documented; and a strategy to address any gaps identified towards enhancing equity in decision making and/or adoption of improved crop varieties. | | | | * Team project report submitted to Africa RISING indicating activities implemented and key results. * Draft manuscript prepared and shared with Chief Scientist for review and record. * Student thesis. (This depends on the recovery of the student) * Female mid-carrier scientist trained (if student recovers). | | | May 2021 | |
| 6.2 Nutrition indices associated with participating persons assembled to inform the benefits of rolling out the technologies at community level | | | | Anthropometric data in project reports and Dataverse | | | May 2021 | |
| 6.3 Partnerships with development partners such as the World Food Programme established for scaling out of research knowledge | | | | Team progress report (technical Oct-Mar & April-Sept) submitted to Africa RISING indicating guidelines to inform nutrition programming in dryland ecologies of central Tanzania.  FtF data, submitted to the M&E Officer for upload to USAID FtF Platform | | | Sep. 2021 | |
| 7. How will scaling be achieved? | | | | | | | | |
| Through establishing partnerships with non-governmental organizations interested in and implementing nutrition-sensitive activities. WFP is already working in Kongwa-Kiteto and will be approached. This will be done after obtaining key results critical for informing scaling-out activities. | | | | | | | | |
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| 8. How are the activities in this protocol linked to those of others? See below for the linkages | | | | | | | | |
| These activities are linked to the systems approach by generating evidence on the effect of productivity on nutrition. It will therefore feed into the systems agronomy, gender, and M&E, and have a comprehensive view on the inter-linkages of Agriculture-Nutrition. | | | | | | | | |

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| 9. Gantt chart | 2021 | | | | | | | | | | | |
| Activity/ month | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec |
| Exploratory visits and pre-testing of tools |  |  |  |  |  |  |  |  |  |  |  |  |
| Study implementation |  |  |  |  |  |  |  |  |  |  |  |  |
| Data clean-up, analysis and write up |  |  |  |  |  |  |  |  |  |  |  |  |
| Learning and sharing /thesis |  |  |  |  |  |  |  |  |  |  |  |  |
| Manuscript drafting of research paper |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | | | | | | |
| a. Output 5.3 | Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners | | | | | | | | | | |
| b. Activity 5.3.1 | Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies | | | | | | | | | | |
| c. Sub-activity 5.3.1.2 | Identify and communicate gender-sensitive decision support tools in the context of different farm typologies | | | | | | | | | | |
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| d. Research team | | | | | | | | | | | |
| Name | Institution | | Role | | | | | | | | |
| Gundula Fischer | IITA | | Principal investigator, social sciences | | | | | | | | |
| Cathy Farnworth | Lead Consultant | | Social scientist: research design, data collection and analysis | | | | | | | | |
| Elirehema Swai | TARI | | Biophysical integration, Tanzania | | | | | | | | |
| Regis Chikowo | MSU | | Biophysical integration, baseline data for selected households, Malawi | | | | | | | | |
| Julius Manda | IITA | | Support with baseline data for selected households, Tanzania | | | | | | | | |
|  | | | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | | | |
|  | | | | | | | | | | | |
| f. Location(s) | Dedza District | | | | | | | | | | |
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| g. Start | 2021 | | | | | | | | | | |
|  | | | | | | | | | | | |
| h. End | 2021 | | | | | | | | | | |
|  | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | |
| In Malawi, Africa RISING interventions revolve around four themes: integrated maize-legume systems (including new bean varieties and double up legumes), livestock intensification (with a focus on poultry and small ruminants), food processing and nutrition, and R4D platforms and networks. In Tanzania, Africa RISING’s research for development activities focused on improved crop varieties, appropriate agronomic practices, climate-smart land management practices, improved animal husbandry practices, and technologies for reducing pre- and post-harvest losses.  Technology testing in Malawi has been accompanied by gender evaluations based on the Sustainable Intensification Assessment Framework (SIAF), mandatory for Africa RISING researchers since 2017. However, an important question has not yet sufficiently been addressed, namely how household decision-making and technology adoption interact. Output 5.3 (Activity 5.3.1) in the logframe for Africa RISING East and Southern Africa stipulates an investigation of this question with an action research approach. The research will combine elements from household methodologies (Gender Action Learning System, GALS) with farmers' exchange visits. The technological focus will be on soil and water conservation technologies and legume-maize integration. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | |
| 2.1 To critically analyze and shift gendered decision-making towards more balance through household methodologies | | | | | | | | | | | |
| 2.2 To capture men and women’s assessment criteria in decision-making for technologies | | | | | | | | | | | |
| 2.3 To develop/adapt and test a workshop format that allows farm household members to self-establish assessment criteria for technologies and make more gender-balanced decisions in relation to validated AR technologies. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 3. Research questions | | | | | | | | | | | |
| 3.1 How are agricultural decisions being made at the household level and why (power balances/imbalances; demarcated areas of responsibility, etc.)? How can balanced decision-making be supported through household methodologies? (Research component 1) | | | | | | | | | | | |
| 3.2 What criteria do men and women farmers use in decision-making for or against technologies (more specifically, how do they assess risks and opportunities)? (Research component 2) | | | | | | | | | | | |
| 3.3 How can results from 1 and 2 be effectively combined in a workshop that allows farmers to explore technologies through a household methodology lens? | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | |
| Experiment design, implementation, and data analysis  We will sample 6 households in a community that has been exposed to the selected Africa RISING technologies and another 6 households that have not been exposed in a neighboring community. The sampling strategy will be purposive. It will be important that participation is truly voluntary and that participating households are provided with information on tools in advance. Respondents will have to be prepared that they will discuss intra-household decision-making (informed consent).  Research component 1: For a baseline of the selected households, we will use Africa RISING panel data in Malawi and data from an economic soil and water conservation survey recently conducted in Tanzania (Julius Manda). We will additionally use household methodology tools for farmers to self-establish a baseline of their households. The collected emic and etic baseline data will relate to decision-making, productivity, labor, and other aspects that are important for a sample description.  Research component 2: We will use mind mapping and clustering (current suggestion) to establish criteria farmers use in relation to technology selection and adoption. This data will form a platform for farmer learning processes.  Research component 3: Household members from exposed and non-exposed communities will be brought together through exchange visits. In workshops, they will apply household methodology tools to explore gendered questions around the selected technologies. Non-exposed farmers will visit the fields of exposed farmers to see how they have implemented the technologies. Farmers will be encouraged to develop their HH visions in relation to technology adoption. All visions are expected to be gender responsive. Ideally, the national facilitators/partners will continue to support the households through at least two follow up visits that could also be used for participatory data collection on developments, challenges, sustainability, etc. (and feed into the final version of the research article as well as their learning processes and practice). | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 5. Data (with indicators and metrics) to be collected and uploaded on DataVerse | | | | | | | | | | | |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | | Farm level metrics | Household level metrics | Community /landscape metrics | Measurement method | | Social | | | | | | | | Gender equity |  |  | | Balances in household decision-making  Gender differences in assessment criteria for technologies |  | Household methodology tools (qualitative) | | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 6. Deliverables | | | Means of verification | | | | | | Delivery date | | |
| 6.1 Community meetings held | | | Community meeting reports | | | | | | Apr. 2021 | | |
| 6.2 Blog contributions | | | Published on Africa RISING website | | | | | | Sep. 2021 | | |
|  | | | | | | | | | | | |
| 7. How will scaling be achieved? | | | | | | | | | | | |
| In this activity, we will cooperate with extension officers in Malawi. In Malawi, the new tools will supplement household methodology tools (such as the gender balance tree) that are already used by extensionists. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others?  This activity is linked to sub-activity 1.2.2.2 Gender analysis of soil and water conservation technologies.  This activity is linked to Sub-activity 1.1.1.2: Investigations on the medium to long-term impacts of SI technologies (improved soil fertility management, improved germplasm, crop combinations, nutrient and water management) on crop productivity on multi-locational field sites. | | | | | | | | | | | |
| 9. Gantt chart | | | | | | | | | | | |
| Activity/ month | | 2021 | | | | | | | | | |
| Jan | Feb | Mar | Apr | May | Jun | Jul | | Aug | Sep |
| Literature review | |  |  |  |  |  |  |  | |  |  |
| Preparation of tools/workshop concept | |  |  |  |  |  |  |  | |  |  |
| Workshop for research preparation | |  |  |  |  |  |  |  | |  |  |
| Data collection | |  |  |  |  |  |  |  | |  |  |
| Workshop for research consolidation | |  |  |  |  |  |  |  | |  |  |
| Data processing and analysis | |  |  |  |  |  |  |  | |  |  |
| Preparation of deliverables | |  |  |  |  |  |  |  | |  |  |

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| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | |
| a. Output 5.3: | | Gender-sensitive decision support tools for farmers to assess technology-associated risk and opportunities used by partners | | | |
| b. Activity 5.3.1: | | Identify and communicate gender-sensitive decision support technologies in the context of different farm typologies | | | |
| c. Sub-activity 5.3.1.4 | | Testing an integrated socio-technological approach with household methodologies | | | |
|  | | | | | |
| d. Research team | | | | | |
| Name | Institution | | | Role | |
| Gundula Fischer | IITA | | | Principal investigator, social sciences | |
| Cathy Farnworth | Lead Consultant | | | Research design, data collection and analysis | |
| Elirehema Swai | TARI | | | Providing technical backstopping on biophysical information | |
| Regis Chikowo | MSU | | | Providing biophysical information and baseline data for selected households, Malawi | |
| Julius Manda | IITA | | | Support with baseline data for selected households, Tanzania | |
|  | | | | | |
| e. Student(s): Nil | | | | | |
|  | | | | | |
| f. Location(s) | Kongwa District, Tanzania and Dedza District, Malawi | | | | |
|  | | | | | |
| g. Start | 2021 | | | | |
|  | | | | | |
| h. End | 2021 | | | | |
|  | | | | | |
| 1. Justification   * In Malawi, Africa RISING interventions revolve around four themes: 1) integrated maize-legume systems (including new bean varieties and double up legumes), 2) livestock intensification (with a focus on poultry and small ruminants), 3) food processing and nutrition, and 4) R4D platforms and networks. In Tanzania, Africa RISING’s research for development activities focused on improved crop varieties, appropriate agronomic practices, climate-smart land management practices, improved animal husbandry practices, and technologies for reducing pre- and post-harvest losses. * Technology testing in both countries has been accompanied by gender evaluations based on the Sustainable Intensification Assessment Framework (SIAF), mandatory for Africa RISING researchers since 2017. However, an important question has not yet sufficiently been addressed, namely how household decision-making and technology adoption interact. Output 5.3 (Activity 5.3.1) in the logframe for Africa RISING East and Southern Africa stipulates an investigation of this question with an action research approach. The research will combine elements from household methodologies (Gender Action Learning System, GALS) with farmers' exchange visits. The technological focus will be on soil and water conservation technologies and legume-maize integration. | | | | | |
|  | | | | | |
| 2. Objectives | | | | | |
| * 2.1 To critically analyze and shift gendered decision-making towards more balance through household methodologies | | | | | |
| * 2.2 To capture men and women’s assessment criteria in decision-making for technologies | | | | | |
| 2.3 To develop/adapt and test a workshop format that allows farm household members to self-establish assessment criteria for technologies and make more gender-balanced decisions in relation to validated AR technologies | | | | | |
|  | | | | | |
| 3. Research questions   * 3.1 How are agricultural decisions being made at the household level and why (power balances/imbalances; demarcated areas of responsibility, etc.)? How can balanced decision-making be supported through household methodologies? (Research component 1) | | | | | |
| * 3.2 What criteria do men and women farmers use in decision-making for or against technologies (more specifically, how do they assess risks and opportunities)? (Research component 2) | | | | | |
| 3.3 How can results from 1 and 2 be effectively combined in a workshop that allows farmers to explore technologies through a household methodology lens? | | | | | |
|  | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | |
| Experiment design, implementation, and data analysis  We will sample 6 households in a community that has been exposed to the selected Africa RISING technologies and another 6 households that have not been exposed in a neighboring community. The sampling strategy will be purposive. It will be important that participation is truly voluntary and that participating households are provided with information on tools in advance. Respondents will have to be prepared that they will discuss intra-household decision-making (informed consent).  4.1 Research component 1: For a baseline of the selected households we will use Africa RISING panel data in Malawi and data from an economic soil and water conservation survey recently conducted in Tanzania (Julius Manda). We will additionally use household methodology tools for farmers to self-establish a baseline of their households. The collected emic and etic baseline data will relate to decision-making, productivity, labor, and other aspects that are important for a sample description.  4.2 Research component 2: We will use mind mapping and clustering (current suggestion) to establish criteria farmers use in relation to technology selection and adoption. This data will form a platform for farmer learning processes.  4.3 Research component 3: Household members from exposed and non-exposed communities will be brought together through exchange visits. In workshops, they will apply household methodology tools to explore gendered questions around the selected technologies. Non-exposed farmers will visit the fields of exposed farmers to see how they have implemented the technologies. Farmers will be encouraged to develop their HH visions in relation to technology adoption. All visions are expected to be gender-responsive. Ideally, the national facilitators/partners will continue to support the households through at least two follow-up visits.  Follow-up visits could also be used for participatory data collection on developments, challenges, sustainability, etc. (and feed into the final version of the research article as well as their learning processes and practice). | | | | | |
|  | | | | | |
| 5. Data to be collected and uploaded on DataVerse   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Domain & *Indicator* | Field/plot level metrics | Farm level metrics | Household level metrics | Community /landscape metrics | Measurement method | | Social |  |  |  |  |  | | Gender equity |  |  | * Balances in household decision-making * Gender differences in assessment criteria for technologies |  | Household methodology tools (qualitative) | | | | | | |
|  | | | | | |
| 6. Deliverables | | | | Means of verification | End date |
| 6.1 Scientific article | | | | Submission confirmation, with draft verification from the Chief Scientist | Sep. 2021 |
| 6.2 Manuals on integrated socio-technological decision-support tools for Malawi and Tanzania | | | | Upload to CGSpace | Sep. 2021 |
| 6.3 Blog | | | | Published on Africa RISING website | Sep. 2021 |
|  | | | | | |
| 7. How will scaling be achieved? | | | | | |
| In this activity, we will cooperate with extension officers in Malawi and Tanzania. In Malawi, the new tools will supplement household methodology tools (such as the gender balance tree) that are already used by extensionists. In Tanzania, we are additionally planning to cooperate with the LEAD Foundation. These actors will be trained in the new household methodology tools and will further apply them. | | | | | |
|  | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | |
| This activity is linked to sub-activity 1.2.2.2 Gender analysis of soil and water conservation technologies and sub-activity 2.2.1.6 | | | | | |
| 9. Gant chart | | | 2021 | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Activity | Jan | Feb | Mar | Apr | Jun | Jul | Aug | Sep |
| Literature review |  |  |  |  |  |  |  |  |
| Preparation of tools/workshop concept |  |  |  |  |  |  |  |  |
| Workshop for research preparation |  |  |  |  |  |  |  |  |
| Data collection |  |  |  |  |  |  |  |  |
| Workshop for research consolidation |  |  |  |  |  |  |  |  |
| Data processing and analysis |  |  |  |  |  |  |  |  |
| Preparation of deliverables |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for scaling sustainable intensification research products and validated innovations operationalized | | | | | | | | | | | |
| a. Output 5.4 | Technology adoption, monitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners] | | | | | | | | | | |
| b. Activity 5.4.1 | Monitor and modify the progress of technology adoption process towards scaling | | | | | | | | | | |
| c. Sub-activity 5.4.1.1 | Populate the Beneficiary and Technology Tracking Tool (BTTT) Tanzania, Malawi, and Zambia with information about AR technologies applied, and farmers/households engaged in validating the technologies | | | | | | | | | | |
|  | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | |
| Name | | Institution | | Role | | | | | | | |
| Daniel Mgalla | | IITA | | Verifying submitted data | | | | | | | |
| Researchers | | AR partners | | Provision of direct beneficiary data | | | | | | | |
| Haile Beliyou | | IFPR | | Verifying submitted data | | | | | | | |
|  | | | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | | | |
|  | | | | | | | | | | | |
| f. Location(s) | | Malawi, Zambia, Tanzania | | | | | | | | | |
|  | | | | | | | | | | | |
| g. Start | | September 2020 | | | | | | | | | |
|  | | | | | | | | | | | |
| h. End | | September 2021 | | | | | | | | | |
|  | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | |
| Collection of beneficiary information is crucial for tracking technology transfer, adoption, and farmers’ response to research activities at different levels for Phase II of Africa RISING Project implementation in ESA. Therefore, continuous update of the Beneficiary and Technology Tracking Tool (BTTT) is critical for the project and forms an important input to periodic reporting to USAID and other interested stakeholders. For a long time, only the names of the beneficiaries were updated and less attention was put on updating the technologies. While updating new beneficiaries will continue next year, the tool will be finalized to be updated with the technologies to ensure that each farmer is mapped to technology of his/her association during development or testing and validating of these technologies. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | |
| 2.1 To harmonize, populate, and document the Beneficiary and Technology Tracking Tool (BTTT) for Tanzania, Malawi, and Zambia | | | | | | | | | | | |
| 2.2 To track the progress of direct beneficiaries against cumulative 2021 targets | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 3. Research questions: NA | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | |
| Experiment design, implementation, and data analysis  Data will be collected from researchers using a standard tool provided to them in June 2020 that the researchers are using to populate names of new beneficiaries and associated technologies). The data to be collected will be on households involved during the phases of technology validation, including gender specificity. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 5. Data to be collected and uploaded in BTTT | | | Responsibility/Institution | | | | | | | | |
| 5.1 Direct beneficiary data | | | AR partners/different institutions,  Daniel Mgalla/IITA | | | | | | | | |
|  | | | | | | | | | | | |
| 6. Deliverables | | | Means of verification | | | | | Delivery date | | | |
| 6.1 Updated, harmonized and documented BTTT for Malawi | | | Activity report submitted to Chief Scientist, progress report submitted to Chief Scientist and updated BTTT in AR Websites | | | | | Jan.- Feb. 2021 | | | |
| 6.2 Updated, harmonized, and documented BTTT version for Zambia | | | Activity report submitted to Chief Scientist, progress report submitted to Chief Scientist and updated BTTT in AR Websites | | | | | Mar. – Apr. 2021 | | | |
| 6.3 Updated, harmonized, and documented BTTT for Tanzania | | | Activity report submitted to Chief Scientist, progress report submitted to Chief Scientist and updated BTTT in AR Websites | | | | | Apr. – Jun. 2021 | | | |
| . | | | | | | | | | | | |
| 7. How will scaling be achieved? NA | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | | | | | | |
| The activity is linked to all other sub-activities associated with technology testing development and validation as outlined in the AR 2020/2021 workplan for all the researchers. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| 9. Gantt chart | | | | | 2021 | | | | | | |
| Activity/ month | | | | | Jan | Feb | Mar | | Apr | May | Jun |
| Update, harmonize and document BTTT for Malawi | | | | |  |  |  | |  |  |  |
| Update, harmonize and document new version of BTTT for Zambia | | | | |  |  |  | |  |  |  |
| Update, harmonize and document BTTT for Tanzania | | | | |  |  |  | |  |  |  |

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| Outcome 5: Partnerships for scaling sustainable intensification research products and validated innovations operationalized | | | | | |
| a. Output 5.4. | Technology adoption, monitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners] | | | | |
| b. Activity 5.4.1 | Monitor and modify the progress of technology adoption process towards scaling | | | | |
| c. Sub-activity 5.4.1.2 | Populate the technology scaling tool with detailed information on scaling data for Tanzania, Malawi, and Zambia | | | | |
|  | | | | | |
| d. Research team | | | | | |
| Name | Institution | | | Role | |
| Daniel Mgalla | IITA | | | Verifying submitted data and tracking progress against targets | |
| Researchers | AR partners | | | Linking AR M&E and Data Manager with development partners | |
| Haile Beliyou | IFPRI | | | Verifying submitted data and tracking progress against targets | |
| Development partners | LEAD Foundation, government agencies, IDP | | | Proving scaling details | |
|  | | | | | |
| e. Student(s): Nil | | | | | |
|  | | | | | |
| f. Location(s) | Malawi, Zambia, Tanzania | | | | |
|  | | | | | |
| g. Start | Sep. 2020 | | | | |
|  | | | | | |
| h. End | Sep. 2021 | | | | |
|  | | | | | |
| 1. Justification | | | | | |
| Collection of beneficiary information is crucial for tracking technology transfer(scaling) and farmers’ response to research activities at different levels for Phase II of Africa RISING Project implementation in ESA. Therefore, continuous update of the scaling tool is critical for the project and forms an important input to periodic reporting to USAID and other interested stakeholders. The scaling tool for the ESA region, therefore, needs to be updated with scaling data when available from different development partners. | | | | | |
|  | | | | | |
| 2. Objectives | | | | | |
| 2.1 To populate and document the scaling tool with detailed data on scaling for Tanzania, Malawi, and Zambia | | | | | |
| 2.2 To track the progress of scaling beneficiaries against targeted cumulative scaling beneficiaries for 2021 | | | | | |
|  | | | | | |
| 3. Research questions NA | | | | | |
|  | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | |
| Experiment design, implementation, and data analysis  Data will be collected from researchers using the standard AR scaling tool or other relevant tools as used by development partners | | | | | |
|  | | | | | |
| 5. Data to be collected and uploaded in Scaling tool | | Responsibility/Institution | | | |
| 5.1 All details of technologies, approaches, and scaling data | | Daniel Mgalla/IITA  Development partners,  Related researchers | | | |
|  | | | | | |
| 6. Deliverables | | | Means of verification | | Delivery date |
| 6.1 Complete package of AR workbook with details on number of scaling beneficiaries, technologies scaled, responsible researcher, name of development partner, scaling approach | | | Activity report submitted to Chief Scientist, progress report submitted to Chief Scientist and updated workbook in AR Websites | | January - August 2021 |
|  | | | | | |
| 7. How will scaling be achieved? NA | | | | | |
|  | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | |
| The activity is linked to all other sub-activities associated with technology scaling (Outcome 5) as outlined in the AR 2020/2021 workplan for all the researchers. | | | | | |
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| 9. Gantt chart | 2021 | | | | | | | | |
| Activity/ month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept |
| Update, harmonize and document scaling tool with all details of technologies (scaling beneficiaries numbers reached, development partners involved, scaling approaches used) for Tanzania |  |  |  |  |  |  |  |  |  |
| Update, harmonize and document scaling tool with all details of technologies (scaling beneficiaries numbers reached, development partners involved, scaling approaches used) for Malawi |  |  |  |  |  |  |  |  |  |
| Update, harmonize and document scaling tool with all details of technologies (scaling beneficiaries numbers reached, development partners involved, scaling approaches used) for Zambia |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for scaling sustainable intensification research products and validated innovations operationalized | | | | | | |
| a. Output 5.4. | Technology adoption, monitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners] | | | | | |
| b. Activity 5.4.1 | Collaborate with lead researchers to monitor and modify the progress of technology adoption process towards scaling | | | | | |
| c. Sub-activity 5.4.1.3 | Design simple research rack up database and populate it with research rack up data for Tanzania, Malawi, and Zambia | | | | | |
|  | | | | | | |
| d. Research team | | | | | | |
| Name | | Institution | | | Role | |
| Daniel Mgalla | | IITA | | | Kobol Toolbox database development and population | |
| Researchers | | AR partners | | | Providing data on research rack up details | |
| Haile Beliyou | | IFRP | | |  | |
|  | | | | | | |
| e. Student(s): Nil | | | | | | |
|  | | | | | | |
| f. Location(s) | | Malawi, Zambia, Tanzania | | | | |
|  | | | | | | |
| g. Start | | Sept 2020 | | | | |
|  | | | | | | |
| h. End | | Sept 2021 | | | | |
|  | | | | | | |
| 1. Justification | | | | | | |
| Researchers for AR have been working on developing, testing, and validating various technologies since 2012. So far, more than 58 technologies have been reported in the FtF indicator sheet. Until now, there is no tool to store or compile detailed information on these technologies but rather pieces of different information reside with the individual researchers. Since 2019, USAID requested to collect this information and populate it in the Research Rack-Up data collection tool which is intended to compile information on research outputs (e.g., technologies, practices, and approaches) that have been created with assistance from Feed the Future. It helps USAID and their research partners to ease tracking of the generation and fate of research products.  The descriptive data collected here is critical in facilitating USAID’s efforts to monitor, evaluate, and communicate the impact of research investments in alignment with the Global Food Security Act’s goals of decreasing global poverty, hunger, and malnutrition.  The Research Rack-Up complements data captured in the Feed the Future Monitoring System (FTFMS), particularly EG.3.2-7 in the [Feed the Future Indicator Handbook](https://www.agrilinks.org/sites/default/files/ftf-indicator-handbook-march-2018-508.pdf) (pg. 85-92), and provides detailed data on Feed the Future research outputs. The data captured will inform:   1. progress and impact of innovations funded by USAID as well as reporting to appropriate congressional committees. 2. facilitation of uptake by curating information on the types of innovations in the research and development pipeline and identifying innovations ready to be handed off for use by Missions, implementing partners, host country entities, and the private sector. 3. development of the evidence needed to manage and implement programs focused on generating and accelerating research impacts.   Based on the nature and complexity of the information needed and its huge volume, there is a need to replicate the same tool at the project level so that it enables us to finally have these information products in one place before reporting to USAID from (October 19 - December 4) 2021. | | | | | | |
|  | | | | | | |
| 2. Objectives | | | | | | |
| 2.1 To develop a simple database in Kobol Toolbox for use in documenting research rack up data that will later be populated in research rack up tool for reporting to USAID | | | | | | |
|  | | | | | | |
| 3. Research questions NA | | | | | | |
|  | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | |
| Experiment design, implementation, and data analysis  I will work with AR researchers to collect data using research rack up data collection tool or smartphones which will later be entered in the developed simple research rack up the database for consolidation at the regional level and later entering at the USAID online research rack up data website | | | | | | |
|  | | | | | | |
| 5. Data to be collected and entered in research rack up tool | | | | Responsibility/Institution | | |
| 5.1 Research rack up data details (research output title, description, output type, phases of the output in R&D, type of technology, technology recipient type and name if scaled, crop/breed type, research partners and type, country/region technology evaluated and released, Feed the Future Innovation Exchange Information (FTFIE), etc. | | | | Daniel Mgalla/ IITA,  AR researchers/partner institutions | | |
|  | | | | | | |
| 6. Deliverables | | | Means of verification | | | Delivery date |
| 6.1 Simple Kobol Toolbox database with all the information about research rack up data (research output title, description, output type, phases of the output in R&D, type of technology, technology recipient type and name if scaled, crop/breed type, research partners, and type, country/region technology evaluated and released, Feed the Future Innovation Exchange Information (FTFIE) for all 58 technologies developed and data entered | | | Database developed data entered, analyzed, and report shared in AR website | | | January - August 2021 |
| 6.2 Research rack up data (research output title, description, output type, phases of the output in R&D, type of technology, technology recipient type and name if scaled, crop/breed type, research partners and type, country/region technology evaluated and released, Feed the Future Innovation Exchange Information (FTFIE) for all 58 technologies submitted to USAID web-based research rack up data for 2021 | | | Activity report submitted to Chief Scientist | | | October - December 2021 |
|  | | | | | | |
| 7. How will scaling be achieved? NA | | | | | | |
|  | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | |
| The activity is linked to all other sub-activities associated with the AR research component (Outcome 1-4) as outlined in the AR 2020/2021 workplan for all the researchers. | | | | | | |

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| 9. Gantt chart | 2021 | | | | | | | | | | | | |
| Activity/ month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Develop a simple Kobol Toolbox database with all the information about research rack up data for all 58 technologies for ESA |  |  |  |  |  |  |  |  |  |  |  |  |
| Enter and compile data in the developed database for ESA |  |  |  |  |  |  |  |  |  |  |  |  |
| Enter compiled research rack up data for all 58 technologies to USAID web-based research rack up database |  |  |  |  |  |  |  |  |  |  |  |  |

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| Outcome 5: Partnerships for scaling sustainable intensification research products and validated innovations operationalized | | | | | | | | | | | | | | |
| a. Output 5.4 | Technology adoption, monitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners] | | | | | | | | | | | | | |
| b. Activity 5.4.1 | Monitor and modify the progress of technology adoption process towards scaling | | | | | | | | | | | | | |
| c. Sub-activity 5.4.1.4 | Conduct data quality assessment (DQA) to verify the number of direct beneficiaries reported against those verified in source data for the selected sites | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| d. Research team | | | | | | | | | | | | | | |
| Name | Institution | | | Role | | | | | | | | | | |
| Daniel Mgalla | IITA | | | Conducting data quality assessment | | | | | | | | | | |
| Haile Beliyou | IFPR | | | Reviewing data quality assessment tools | | | | | | | | | | |
| Researchers | AR partners | | | Provision of source data for direct and scaling beneficiaries to be used for comparing with reported numbers | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| e. Student(s): Nil | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| f. Location(s) | Malawi, Zambia, Tanzania | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | |
| g. Start | Sept 2020 | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | |
| h. End | Sept 2021 | | | | | | | | | | | | | |
|  |  | | | | | | | | | | | | | |
| 1. Justification | | | | | | | | | | | | | | |
| Since project inception, researchers have submitted names and number of beneficiaries reached in various villages for all countries along with the technologies these beneficiaries implement. These numbers have been reported for both direct and scaling beneficiaries from these villages country wide. However, the project hasn’t conducted any single data quality exercise to at least get insights on the validity of numbers being reported. In 2021, the M&E officer in collaboration with researchers will conduct data quality assessment in selected villages from all ESA countries to get a sense of how valid, accurate and reliable these data are and write a report that will inform the project management and researchers on the status of the data the project has been reporting to the donor over the last 8 years. Therefore, this will help to verify the project data reported by AR researchers against the source data at the village level. | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 2. Objectives | | | | | | | | | | | | | | |
| * 2.1 To assess the quality of data (reports), in terms of its concordance with the source data forms registers submitted by AR researchers through standard data quality parameters such as its validity, reliability, timeliness, precision, and integrity into the BTTT | | | | | | | | | | | | | | |
| 2.2 To assess the completeness of beneficiary’s data in registries at village level | | | | | | | | | | | | | | |
| 2.3 To estimate the margin of error of reported data vis-à-vis source data, by villages and district | | | | | | | | | | | | | | |
| 2.4 To assess the flow of data from the initial collection point(researchers) to the subsequent higher level (IITA) | | | | | | | | | | | | | | |
| 2.5 To identify areas of potential vulnerability that affect the general credibility and usefulness of the Datasets | | | | | | | | | | | | | | |
| 2.6 To recommend measures to address any identified weaknesses in the data submitted by researchers | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 3. Research questions: NA | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | | | | | | | | | |
| Experiment design, implementation, and data analysis  To meet all the objectives set out, a sample of villages will be selected using simple random sampling selected across all 3 countries' specific districts and AR sites. The total number of direct beneficiaries reported in the BTTT tool for a selected village will be compared to the number recorded in the source document available at the village level. Assessment will use the standard data quality assessment tool which is to be adopted from USAID  Key standard data quality parameters to this assessment will be as follows.   |  |  | | --- | --- | | Data quality dimensions | Operational definition | | Completeness | Defined by the existence of beneficiary data in selected AR sites for a set of key variables | | Concordance | Defined by data reported in BTTT compared with primary sources of data available at AR sites for particular researchers | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 5. Data to be used for comparison | | | | | | | Responsibility/Institution | | | | | | | |
| 5.1 Direct beneficiary data registry at village level | | | | | | | AR researchers | | | | | | | |
| 5.2 Direct beneficiary data available in BTTT for comparison with the registry at village level | | | | | | | Daniel Mgalla/IITA | | | | | | | |
|  | | | | | | | | | | | | | | |
| 6. Deliverables | | | Means of verification | | | | | | | Delivery date | | | | |
| 6.1 Project Data quality assessment report for ESA region (Tanzania, Malawi, and Zambia) | | | Report shared with chief scientist and published in AR website | | | | | | | February - March 2021 | | | | |
|  | | | | | | | | | | | | | | |
| 7. How will scaling be achieved? NA | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| 8. How are the activities in this protocol linked to those of others? NA | | | | | | | | | | | | | | |
| 9. Gantt chart | | 2021 | | | | | | | | | | | | |
| Activity/ month | | Jan | | | Feb | Mar | | Apr | May | | Jun | Jul | Aug | Sep |
| Select sites (village) to be included in the data quality assessment for Malawi, Tanzania, and Zambia | |  | | |  |  | |  |  | |  |  |  |  |
| Conduct data quality assessment | |  | | |  |  | |  |  | |  |  |  |  |
| Write-up project data quality assessment report | |  | | |  |  | |  |  | |  |  |  |  |

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| Outcome 5: Partnerships for scaling sustainable intensification research products and validated innovations operationalized | | | | | |
| a. Output 5.4. | Technology adoption, monitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners] | | | | |
| b. Activity 5.4.1 | Monitor and modify the progress of technology adoption process towards scaling | | | | |
| c. Sub-activity 5.4.1.5 | Provide additional capacity building and work with ESA research partners to ensure timely (and complete) submission of FTF indicators data, research rack up data, country narratives, IM performance narratives for the Fiscal Year 2021, compliance with the AR Data Management Plan (Dataverse data uploading and sharing) | | | | |
|  | | | | | |
| d. Research team | | | | | |
| Name | Institution | Role | | | |
| Daniel Mgalla | IITA | 1. Capacitate researchers on quality submission of data for Dataverse 2. Capacitate researchers on proper submission of FtF data to address gaps in achievement and target data mismatch for age-gender disaggregation, narratives for 10% difference, IM performance, and country narratives 3. Review submitted FtF data, datasets, and meta-data before submission into Dataverse | | | |
| Haile Beliyou | IFPRI | Reviewing final submitted FtF data and datasets before submission into DIS and Dataverse | | | |
| AR Researchers | AR partners | Providing data sets, FtF indicators, and meta-data for review | | | |
|  | | | | | |
| e. Student(s): Nil | | | | | |
|  | | | | | |
| f. Location(s) | Malawi, Zambia, Tanzania | | | | |
|  | | | | | |
| g. Start | Sept 2020 | | | | |
|  | | | | | |
| h. End | Sept 2021 | | | | |
|  | | | | | |
| 1. Justification | | | | | |
| Working with researchers is important to ensure timely and complete submission of FtF indicators data in each Fiscal Year. To guide them to review their target data, compile FtF data on actual achievements on yearly bases, ensure data are consistent with an adequate level of (dis)aggregation and write narrative information every time the difference between actual and target is more/less than 10%. During the submission of these data in the last reporting period, nearly all researchers had noted gaps in their submitted FTF data and IM performance narratives. Because of this, I will conduct capacity building sessions for researchers in Malawi, Zambia, and Tanzania to train them on data quality issues they need to be aware of when filling the FtF indicator forms along with their research rack up data and IM performance narratives. | | | | | |
|  | | | | | |
| 2. Objectives | | | | | |
| 2.1 To ensure timely (and complete) submission of FtF indicators data for the Fiscal Year 2021, compliance with the AR Data Management Plan (Dataverse data uploading and sharing), and collection of scale-up data and beneficiaries  2.2 To ensure timely uploading of FtF data IM performance and country narratives, research rack up data in the new USAID DIS system  2.3 To capacitate researchers on how best to fill the FtF indicators, research rack up data collection tool and IM performance narratives | | | | | |
|  | | | | | |
| 3. Research questions: NA | | | | | |
|  | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | |
| Experiment design, implementation, and data analysis  AR researchers submit to M&E & data manager all the FtF, Datasets and metadata, IM performance narratives for reviewing the key data quality dimensions as per data management plan and uploading to the corresponding systems (DIS and Dataverse). | | | | | |
|  | | | | | |
| 5. Data to be used, collected, and uploaded | | | | Responsibility/Institution | |
| 5.1 Datasets and metadata | | | | AR researchers/partner institutions | |
| 5.2 FTF data | | | | AR researchers/partner institutions | |
| 5.3 Reviewed data sets, meta-data, IM performance narratives, and country narratives | | | | Daniel Mgalla/IITA | |
|  | | | | | |
| 6. Deliverables | | | Means of verification | | Delivery date |
| 6.1 Training materials | | | Report shared to chief scientist and uploaded in AR website | | Apr. – Jun. 2021 |
| 6.2 Workbook with data summary on 2021 achievements on the five FtF indicators and for each ESA country, (dis)aggregated by individual research theme/group who submitted indicator target and additional data as necessary, list of IM performance and country narratives, research rack up data | | | Activity report, progress report, and FtF data, narratives uploaded in DIS system | | Sep. – Nov. 2021 |
| 6.3 Workbook with a list of research themes/groups by country, PIs, and their email contact, associated to datasets collected and to be collected, etc., since 2013 (according to the proposals) | | | Activity report, progress report, and data submitted in Dataverse | | Jul. – Oct. 2021 |
|  | | | | | |
| 7. How will scaling be achieved? NA | | | | | |
|  | | | | | |
| 1. How are the activities in this protocol linked to those of others? | | | | | |
| The activity is linked to all other sub-activities associated with AR research component (outcome 1-4) as outlined in the AR 2020/2021 workplan for all the researchers. | | | | | |

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| --- | --- | --- | --- | --- | --- |
|  | | | | | |
| 9. Gantt chart | 2021 | | | | |
| Activity/ month | May | Jun | Jul | Aug | Sep |
| Provide additional capacity building to researchers on quality submission of data for Dataverse (submitted data sets and metadata for the inclusion of PII and whether metadata addresses SIF domains as identified in researchers’ workplans) FtF indicators to address gaps in achievement and target data mismatch for age-gender disaggregation, narratives for 10% difference, for Tanzania |  |  |  |  |  |
| Provide additional capacity building to researchers on quality submission of data for Dataverse (submitted data sets and metadata for the inclusion of PII and whether metadata addresses SIF domains as identified in researchers’ workplans) FtF indicators to address gaps in achievement and target data mismatch for age-gender disaggregation, narratives for 10% difference, for Malawi |  |  |  |  |  |
| Provide additional capacity building to researchers on quality submission of data for Dataverse (submitted data sets and metadata for the inclusion of PII and whether metadata addresses SIF domains as identified in researchers’ workplans), FtF indicators to address gaps in achievement, and target data mismatch for age-gender disaggregation, narratives for 10% difference, for Zambia |  |  |  |  |  |
| Reviewing submitted FtF data for correct alignment with targets, achievements, age-gender disaggregation, narratives for 10% difference, compiling submitted FTF data for all researchers, compiling IM performance and country narratives |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Outcome 5Partnerships for scaling sustainable intensification research products and validated innovations operationalized | | | | | | |
| a. Output 5.4. | Technology adoption, monitoring, evaluation, and learning framework for use by the project team and scaling partners released [led by IFPRI and used by project partners] | | | | | |
| b. Activity 5.4.1 | Monitor and modify the progress of technology adoption process towards scaling | | | | | |
| c. Sub-activity 5.4.1.6 | Contribute to the development and implementation of learning efforts, documentation, and sharing of findings and best practices | | | | | |
|  |  | | | | | |
| d. Research team | | | | | | |
| Name | | Institution | Role | | | |
| Daniel Mgalla | | IITA | Contribute to developing presentations, abstracts, articles, and publications through data analysis, tabulation, visualization, and supporting data interpretation for the study ("Farmers’ perception on onset and cessation of rainfall”) by F. Muthoni | | | |
| Haile Beliyou | | IFPRI | Contribute to developing presentations, abstracts, articles, and publications through data analysis, tabulation, visualization, and supporting data interpretation for the study ("Farmers’ perception on onset and cessation of rainfall”) by F. Muthoni | | | |
| Francis Muthoni | | IITA | Implementing study ("Farmers’ perception on onset and cessation of rainfall”) | | | |
| AR Communication Team | | IITA | Developing knowledge products | | | |
| Bekunda Mateete, Fred Kizito | | IITA | Preparation of tabular matrix for M&E team to provide scaling beneficiaries’ data | | | |
|  | |  |  | | | |
| e. Student(s): Nil | | | | | | |
|  | |  | | | | |
| f. Location(s) | | Malawi, Zambia, Tanzania | | | | |
|  | |  | | | | |
| g. Start | | Sep. 2020 | | | | |
|  | |  | | | | |
| h. End | | Sep. 2021 | | | | |
|  | | | | | | |
| 1. Justification | | | | | | |
| AR researchers, chief scientists, and the communication team identified above are planning and have underway studies related to technology adoption and are documenting scaling experiences within the entire Africa RISING program. To complete the tasks ahead, they will need to be provided with data that would aid proper report generation. For the study that is to be conducted by F. Muthoni, ("Farmers’ perception on onset and cessation of rainfall”) he will need to be supported on major key issues related to data collection, verification, and analysis. For the documentation on scaling being done by the chief scientist, they will need to be provided with approaches, processes, and scaling numbers from development partners. Given the above, I will therefore play a major role to ensure that all the planned tasks are completed on time as per the plan they have put forth for 2021. | | | | | | |
|  | | | | | | |
| 2. Objectives | | | | | | |
| 2.1 To support the study on farmers’ perception of the onset and cessation of rainfall | | | | | | |
| 2.2 To support Chief Scientists with the provision of analyzed data for the documentation of scaling experiences | | | | | | |
| 2.3 To support the Communication Team with scaling details during the planned development of knowledge products on scaling | | | | | | |
|  | | | | | | |
| 3. Research questions NA | | | | | | |
|  | | | | | | |
| 4. Procedures (survey methods, gender disaggregation, treatments, experimental design, sample size, etc.) | | | | | | |
| Experiment design, implementation, and data analysis   1. Design/script data collection tool in the Kobol Toolbox 2. Collect, verify, and analyze data and assist in producing the report for the specific study in collaboration with F. Muthoni 3. Provide scaling approaches, processes, and required data for the scaling documentation by chief scientists 4. Provide technology scaling details to the communication team to help prepare the knowledge product on technology scaling | | | | | | |
|  | | | | | | |
| 5. Data to be used, collected, and uploaded | | | | | Responsibility/Institution | |
| 5.1 Data on findings after the study has been completed and uploaded on Dataverse | | | | | Francis Muthoni/IITA | |
|  | | | | | | |
| 6. Deliverables | | | | Means of verification | | Delivery date |
| 6.1 Policy briefs, reports, and other related knowledge products and scientific publications | | | | Confirmation from journal of acceptance of article, CG space | | Feb. – Sep. 2021 |
|  | | | | | | |
| 7. How will scaling be achieved? NA | | | | | | |
|  | | | | | | |
| 8. How are the activities in this protocol linked to those of others? | | | | | | |
| The activity is linked to other sub-activities as identified in ESA 2020/2021 work plan as shown by the identified researchers. | | | | | | |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9. Gantt activity | 2021 | | | | | | | | |
| Activity/ month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Design/script data collection tool in the Kobol Toolbox and conduct field data collection on the study (farmer’s perception on onset and cessation of rainfall study) |  |  |  |  |  |  |  |  |  |
| Provide scaling approaches, processes, and required data for the scaling documentation by Chief Scientists |  |  |  |  |  |  |  |  |  |
| Provide technology scaling details to communication team to aid in the preparation of knowledge product on technology scaling |  |  |  |  |  |  |  |  |  |

# Consolidated ESA 2020-2021 project budget

| Sub-activity/ institute | Leader | CIMMYT | MSU | ICRAF | CIAT | IITA | WorldVeg | WUR | TARI-Hombolo | ICRISAT | Total | percentage of total |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome 1: Productivity, diversity, and income of crop-livestock systems in selected agro-ecologies enhanced under climate variability | | | | | | | | | | | | |
| 1.1.1.2 Investigations on the medium to long-term impacts of SI technologies (improved soil fertility management, improved germplasm, crop combinations, nutrient and water management) on crop productivity on multi-locational field sites and baby trials | MSU |  | 85,034 |  |  | 2,500 |  |  |  |  | 87,534 | 7.58 |
| 1.1.1.5: Determining the productivity and resilience benefits of Gliricidia-based cropping systems | ICRAF |  |  | 67,784 |  | 1,600 |  |  |  |  | 69,384 | 6.01 |
| 1.1.1.6 Assess the uptake and adaptation of new crop configurations- (Mbili Mbili technology)- and understand the influencing factors | CIAT |  |  |  | 71,370 | 3,560 |  |  |  |  | 74,930 | 6.49 |
| 1.1.1.8 Exploring the sustainable intensification pathways of farming system case studies in Tanzania and assessing the impact of Africa RISING technologies on resilience | IITA-Claessens |  |  |  |  | 7,750 |  |  |  |  | 7,750 | 0.67 |
| 1.1.1.9 Assess the impacts of AfricaRISING technologies on the performance and resilience of multi-location and differentially exposed farming systems case studies in Malawi | IITA-Claessens |  |  |  |  | 7,750 |  |  |  |  | 7,750 | 0.67 |
| 1.1.2.1 Assessment of the benefits of management technologies on performance of improved vegetable varieties (season 2) | WorldVeg |  |  |  |  |  | 0 |  |  |  | 0 | 0.00 |
| 1.2.2.1 Use of tractor mounted ripper tillage implement for enhancing soil water infiltration and moisture conservation in semi-arid areas of Kiteto, Manyara Region | TARI-Hombolo |  |  |  |  | 1,500 |  |  | 5,800 |  | 7,300 | 0.63 |
| 1.3.1.2 Refine regionally relevant extrapolation domain maps for validated conservation agriculture (CA) practices | IITA-Muthoni |  |  |  |  | 26,140 |  |  |  |  | 26,140 | 2.26 |
| 1.3.1.3 Produce regionally relevant extrapolation domain maps for validated soil and water conservation practices | IITA-Muthoni |  |  |  |  | 2,000 |  |  |  |  | 2,000 | 0.17 |
| TOTAL OUTCOME 1 |  | 0 | 85,034 | 67,784 | 71,370 | 52,800 | 0 | 0 | 5,800 | 0 | 282,788 | 24.48 |
| Outcome 2: Natural resource integrity and resilience to climate change enhanced for the target communities and agro-ecologies | | | | | | | | | | | | |
| 2.1.1.1 Assessing the buffer and adapative capacity to harness the resilience of different farm types | WUR |  |  |  |  |  |  | 0 |  |  | 0 | 0.00 |
| 2.2.1.2 Investigations on nutrient and water management for climate resilience along a climate gradient in southern Malawi | MSU |  | 13,756 |  |  | 2,500 |  |  |  |  | 16,256 | 1.41 |
| 2.2.1.3 Test climate-smart farming practices (tied ridges, weather informed varieties, cover crops integraton [cowpea, medium duration pigeon pea]) for increasing productivity of maize-legume system under variable weather conditions | CIAT |  |  |  | 11,575 |  |  |  |  |  | 11,575 | 1.00 |
| 2.2.1.6 Validation of residual tied ridging as a labor-saving technology in semi-arid Areas of Central Tanzania | TARI-Hombolo |  |  |  |  |  |  |  | 25,155 |  | 25,155 | 2.18 |
| TOTAL OUTCOME 2 |  | 0 | 13,756 | 0 | 11,575 | 2,500 | 0 | 0 | 25,155 | 0 | 52,986 | 4.59 |
| Outcome 3: Food and feed safety, nutritional quality, and income security of target smallholder families improved equitably (within households) | | | | | | | | | | | | |
| 3.1.1.1 Assess the impact of nutritional messaging on farmers' nutritional knowledge, attitude and practices and household nutrition status, n partnership with Islands of Peace | WorldVeg |  |  |  |  |  | 0 |  |  |  | 0 | 0.00 |
| 3.1.1.2 Evaluate the influence of farmer storage structures and environment on physical and economic losses abatement by hermentic storage devices | IITA-Fischer |  |  |  |  | 8,360 |  |  |  |  | 8,360 | 0.72 |
| 3.2.1.1 Elucidate pathways to sustainable adoption of nutrient diets and aflatoxin mitigation practices in rural communities of Central Tanzania | ICRISAT |  |  |  |  | 500 |  |  |  | 17,943 | 18,443 | 1.60 |
| TOTAL OUTCOME 3 |  | 0 | 0 | 0 | 0 | 8,860 | 0 | 0 | 0 | 17,943 | 26,803 | 2.32 |
| Outcome 4: : Functionality of input and output markets and other institutions to deliver demand-driven sustainable intensification research products improved | | | | | | | | | | | | |
| Sub-activity 4.1.1.2 Enhancement of the groundnut seed value chain in central Tanzania: Imperatives for improving functionality | ICRISAT |  |  |  |  | 1,000 |  |  |  | 21,308 | 22,308 | 1.93 |
| 4.1.1.3 Assess how ISFM practices affect farmers’ livelihoods as a result of Africa RISING activities in Babati | CIAT |  |  |  | 159,032 | 3,000 |  |  |  |  | 162,032 | 14.03 |
| 4.1.1.4 Assess how the implementation of ISFM practices affect farmers’ livelihoods as a result of Africa RISING activities in Kongwa | TARI-Hombolo |  |  |  |  |  |  |  | 33,659 |  | 33,659 | 2.91 |
| 4.1.1.5 Value chain analysis of nutrient-dense common bean varieties in Malawi | MSU |  | 39,573 |  |  | 9,000 |  |  |  |  | 48,573 | 4.21 |
| TOTAL OUTCOME 4 |  | 0 | 39,573 | 0 | 159,032 | 13,000 | 0 | 0 | 33,659 | 21,308 | 266,572 | 23.08 |
| Outcome 5: Partnerships for the scaling of sustainable intensification research products and innovations operationalized | | | | | | | | | | | | |
| 5.1.1.1 Continued experimentation in 6 target communities of Eastern Zambia and 9 communities in Central and Southern Malawi with already established clustered CA trials | CIMMYT | 168,120 |  |  |  |  |  |  |  |  | 168,120 | 14.55 |
| 5.1.1.2 Explore the productivity domains of selected legumes and cereals to elucidate their best fitting cropping system at community/landscape level and their dissemination | ICRISAT |  |  |  |  | 500 |  |  |  | 40,280 | 40,780 | 3.53 |
| 5.1.1.4a Case-studies: Application of SI technologies use among farmers interacting with Africa RISING at different intensities | CIMMYT | 42,209 |  |  |  |  |  |  |  |  | 42,209 | 3.65 |
| 5.1.1.4b Case-studies: Application of SI technologies use among farmers interacting with Africa RISING at different intensities | MSU |  | 111,220 |  |  | 11,500 |  |  |  |  | 122,720 | 10.62 |
| 5.1.1.5 Panel survey, soils processing and meta-analysis studies for maize-grain legumes sequences and implications for sustainability | MSU |  | 41,268 |  |  | 2,500 |  |  |  |  | 43,768 | 3.79 |
| 5.1.2.1 Apply APSIM crop simulation model to assess changes in resource use efficiencies, productivity and profitability of the different cropping systems in Kongwa, Kiteto and Iringa in Tanzania | ICRISAT |  |  |  |  | 500 |  |  |  | 17,380 | 17,880 | 1.55 |
| 5.1.2.2 Evaluate the potential contributions of integrated soil-fertility management around the five SIAF domains with emphasis on Africa RISING interventions in Tanzania | CIAT |  |  |  | 25,893 |  |  |  |  |  | 25,893 | 2.24 |
| 5.1.6.1 Small-scale piloting of FarmMATCH – a framework for typology-based targeting and scaling of agricultural innovations. (Matching Agricultural Technologies to Farms and their Context) | WUR |  |  |  |  |  |  | 0 |  |  | 0 | 0.00 |
| 5.1.7.4 Assess the effect of tied ridging, residual tied and rip tillage on maize productivity, net crop returns, household income and food security | IITA-Manda |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| 5.2.2.1 Support the Ministry of Agriculture and NGO extension in scaling CA systems in Eastern Zambia and Malawi | CIMMYT | 14,807 |  |  |  |  |  |  |  |  | 14,807 | 1.28 |
| 5.2.2.3 Partnership with Iles de Paix (IDP) for increasing the adoption of improved vegetable varieties and good agricultural practices (GAP) in vegetable production in 9 new villages in Karatu | WorldVeg |  |  |  |  |  | 0 |  |  |  | 0 | 0.00 |
| 5.2.2.7 Partnership with LEAD Foundation to take to scale soil and water management technologies in erosion-prone areas of Central Tanzania | TARI-Hombolo |  |  |  |  |  |  |  | 5,000 |  | 5,000 | 0.43 |
| 5.3.1.1 Role of gender from farm-to-fork and the market of grain legumes and dryland cereals in Kiteto and Kongwa (data already collected and partly presented; more in-depth analysis needed) | ICRISAT |  |  |  |  |  |  |  |  | 20,164 | 20,164 | 1.75 |
| 5.3.1.2 Identify and communicate gender-sensitive decision support tools in the context of different farm typologies | IITA-Fischer |  | 3,200 |  |  | 2,500 |  |  |  |  | 5,700 | 0.49 |
| 5.3.1.4 Testing an integrated socio-technological approach with household methodologies | TARI-Hombolo plus IITA-fischer |  |  |  |  | ? |  |  | 4,500 |  | 4,500 | 0.39 |
| 5.4.1.1 Populating the Beneficiary and Technology Tracking Tool (BTTT) and scaling tool for Tanzania, Malawi, and Zambia with information about AR technologies applied, and farmers/households engaged in validating the technologies, scaling beneficiaries | IITA-Mgalla |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| 5.4.1.2 Conduct data quality assessment (DQA) to verify number of direct beneficiaries reported against those verified in selected sites | IITA-Mgalla |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| 5.4.1.2 Provide additional training and work with ESA research partners to ensure timely (and complete) submission of FTF indicators data, research rack up data, country narratives, IM performance narratives for Fiscal Year 2021, compliance with the AR Data Management Plan (Dataverse data uploading and sharing) | IITA-Mgalla |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| 5.4.1.3 Design simple research rack up database and populate it with research rack up data for Tanzania, Malawi, and Zambia | IITA-Mgalla |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| 5.4.1.4 Conduct data quality assessment (DQA) to verify the number of direct beneficiaries reported against those verified in source data for the selected sites | IITA-Mgalla |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| 5.4.1.5 Provide additional capacity building and work with ESA research partners to ensure timely (and complete) submission of FTF indicators data, research rack up data, country narratives, IM performance narratives for Fiscal Year 2021, compliance with the AR Data Management Plan (Dataverse data uploading and sharing) | IITA-Mgalla |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| 5.4.1.6 Work with researchers to undertake various targeted studies on technology adoption, technology scaling in various phases to different entities | IITA-Mgalla |  |  |  |  | 1,800 |  |  |  |  | 1,800 | 0.16 |
| TOTAL Outcome 5 |  | 225,136 | 155,688 | 0 | 25,893 | 31,900 | 0 | 0 | 9,500 | 77,824 | 525,941 | 45.53 |
| TOTAL workplan |  | 225,136 | 294,051 | 67,784 | 267,870 | 109,060 | 0 | 0 | 74,114 | 117,075 | 1,155,090 | 100 |
| TOTAL Percentage |  | 19.49 | 25.46 | 5.87 | 23.19 | 9.44 | 0.00 | 0.00 | 6.42 | 10.14 | 100 |  |

# Feed the Future and Custom Indicators

|  |  |  |
| --- | --- | --- |
| Indicator code | Feed the Future or Custom | FY 2021  Target |
|  | |  |
| 4.5.2(42): (4.5.2-28) | Number of for-profit private enterprises, producers’ organizations, water users’ associations, women’s groups, trade and business associations and community-based organizations (CBOs) that applied improved organization-level technologies or management practices with USG assistance |  |
|  | Type of organization |  |
|  | Private enterprises (for profit) |  |
|  | Producers organizations |  |
|  | Water users’ associations |  |
|  | Women's groups |  |
|  | Trade and business associations |  |
|  | Community-based organizations (CBOs) |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
| 4.5.2(2) | Number of ha of land under improved technologies or management practices with USG assistance |  |
|  | Technology type |  |
|  | crop genetics (maize, p'pea, sorghum, bambara, g/nut, livestock forages) |  |
|  | pest management |  |
|  | disease management (MLN) |  |
|  | soil-related |  |
|  | Irrigation |  |
|  | water management |  |
|  | climate mitigation or adaptation |  |
|  | Other |  |
|  | total w/one or more improved technology |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Joint |  |
|  | Association-applied |  |
|  | Disaggregates Not Available |  |
| EG.3.2-1: (4.5.2-7) | Number of individuals who have received USG-supported short-term agricultural sector productivity or food security training |  |
|  | Type of individual |  |
|  | Producers |  |
|  | People in government |  |
|  | People in private sector firms |  |
|  | People in civil society |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Disaggregates Not Available |  |
| 4.5.2(11): | Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance (RIA) (WOG) |  |
|  | Type of organization |  |
|  | Private enterprises (for profit) |  |
|  | Producers organizations |  |
|  | Water users associations |  |
|  | Women's groups |  |
|  | Trade and business associations |  |
|  | Community-based organizations (CBOs) |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
| EG.3.2-17: (4.5.2-5) | Number of farmers and others who have applied improved technologies or management practices with USG assistance |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Disaggregates Not Available |  |
| 4.5.2(12): | Number of public-private partnerships formed as a result of FTF assistance |  |
|  | Agricultural production (NAFAKA) |  |
|  | Agricultural post harvest transformation |  |
|  | Nutrition (Tuboreshe Chakula?) |  |
|  | Multi-focus |  |
|  | Other |  |
|  | Disaggregates Not Available |  |
| EG.3.2-x27: (4.5.2-27) | Number of members of producer organizations and community-based organizations receiving USG assistance (S) |  |
|  | Type of organization |  |
|  | Producers’ organization |  |
|  | Non-producer-organization CBO |  |
|  | Disaggregates Not Available |  |
|  | Sex |  |
|  | Male |  |
|  | Female |  |
|  | Disaggregates Not Available |  |
| (4.5.2(42): (4.5.2-28). | Number of private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and CBOs that applied improved technologies or management practices as a result of USG assistance |  |
|  | Type of organization |  |
|  | Private enterprises (for profit) |  |
|  | Producers organizations |  |
|  | Water users associations |  |
|  | Women's groups |  |
|  | Trade and business associations |  |
|  | Community-based organizations (CBOs) |  |
|  | Disaggregates Not Available |  |
|  | New/Continuing |  |
|  | New |  |
|  | Continuing |  |
|  | Disaggregates Not Available |  |
| 4.5.2(39): | Number of technologies or management practices in one of the following phases of development: (Phase I/II/III) (S) |  |
|  | Phase 1 Number of new technologies or management practices under research as a result of USG assistance |  |
|  | Phase 2 Number of new technologies or management practices under field testing as a result of USG assistance |  |
|  | Phase 3 Number of new technologies or management practices made available for transfer as a result of USG assistance |  |
|  | Number of children under 2 (0-23 months) reached with community-level nutrition interventions through USG-supported programs |  |
|  | Male |  |
|  | Female |  |
|  | Number of individuals receiving nutrition-related professional training through USG-supported programs |  |
|  | Male |  |
|  | Female |  |
|  |  |  |
| 1 | Number of community-based, regional and national networks and partners established to exchange knowledge and information. |  |
| 2 | Number of on-farm demonstrations established |  |
| 3 | Number of field days organized |  |
| 4 | Number of youth and women participating in project activities |  |
| 5 | Youth |  |
| 6 | Women |  |
| 7 | Number of households using climate information or implementing risk-reducing actions to improve resilience to climate change |  |
| 8 | Number of guidelines and training materials developed by AR researchers? Maybe disaggregate by topic of training |  |
| 9 | Number of graduate (MSc and PhD) students trained as part of AR |  |
| 10 | PhD |  |
| 11 | New |  |
| 12 | Continuing |  |
| 13 | MSc |  |
| 14 | New |  |
| 15 | Continuing |  |
| 16 | Number of AR project reports produced |  |
| 17 | Number of AR-based journal papers published |  |
| 18 | Number of posters, policy briefs, leaflets and films produced by AR researchers |  |
| 19 | Number of radio and TV discussions organized by AR researchers |  |
| 20 | Number of households benefiting from nutrition intervention due to AR |  |
| 21 | Percent change in dietary diversity score of farm household in the project intervention communities. |  |
| 22 | Number of households, especially women with access to home or community garden due to AR |  |
| 23 | Number of women and youth participating in production and marketing decisions as a result of AR |  |
| 24 | Youth |  |
| 25 | Women |  |
| 26 | Percent aflatoxin reduction at harvest through use of Aflasafe in the field |  |
| 27 | Number of published guidelines on market opportunities and market niches |  |
| 28 | Number of community-based producers' organizations established and/or strengthened for production, processing and marketing. |  |
| 29 | Number of households clustered to viable value chains by type of market orientation |  |
| 30 | Number of agricultural and nutritional enabling policies, regulations and administrative procedures recommended and communicated by AR researchers |  |
| 31 | Number of knowledge sharing centers and learning-alliances developed AR researchers within existing local and regional institutions. |  |
| 32 | Number of people trained in CSA including PICSA approach. |  |
| 33 | Number of farmers using climate information in their decision-making |  |

1. Smith, A., Snapp, S., Dimes, J., Gwenambira, C., and Chikowo R. 2016. Doubled-up legume rotations improve soil fertility and maintain productivity under variable conditions in maize-based cropping systems in Malawi. Agricultural Systems. 145: 139–149. [↑](#footnote-ref-1)
2. Snapp, S.S., P. Grabowski, R. Chikowo, A. Smith, E. Anders, D. Sirrine, V. Chimonyo and M. Bekunda. 2018. Maize yield and profitability tradeoffs with social, human and environmental performance: Is sustainable intensification feasible? Agricultural Systems 162: 77-88. [↑](#footnote-ref-2)
3. Chimonyo VGP, Snapp S, Chikowo R 2019. Grain Legumes Increase Yield Stability in Maize Based Cropping Systems. Crop Science 59: 1222–1235. doi:10.2135/cropsci2018.09.0532. [↑](#footnote-ref-3)
4. Smith, A., Snapp, S., Dimes, J., Gwenambira, C., and Chikowo R. 2016. Doubled-up legume rotations improve soil fertility and maintain productivity under variable conditions in maize-based cropping systems in Malawi. Agricultural Systems. 145: 139–149. [↑](#footnote-ref-4)
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